IWRSS Stakeholder Survey

Ohio River Basin Results *August 27, 2014*

A consortium consisting of the U.S. Geological Survey (USGS), the U.S. Army Corps of Engineers (USACE), and the National Oceanic and Atmospheric Administration (NOAA) supports Integrated Water Resources Science and Services (IWRSS). These IWRSS partner agencies are collaborating to design, develop and implement a national water modeling and information services framework to:

1) Infuse new hydrologic science into current water resource management;
2) Develop hydrologic techniques and information to support operational water resources decisions; and
3) Provide advanced hydrologic services to meet stakeholder needs.

On behalf of NOAA, ERG conducted a survey to allow stakeholders in the Ohio River Basin to articulate and prioritize water resources information needs, describe barriers to obtaining useful information, and identify the potential benefits of filling information gaps.[1] Results of the survey will inform future investment in information and services provided by IWRSS.

The survey was open from July 1 to Aug 1, 2014 and received 153 complete responses. Invitations and reminders were emailed to a list of 435 stakeholders compiled with assistance from the Ohio River Valley Water Sanitation Commission (ORSANCO) and other organizations in the river basin;[2] stakeholders could also respond to the survey via links posted on the ORSANCO Web site and distributed by the Cumberland River Compact.

In addition to complete submissions, there were 36 incomplete survey responses. ERG reviewed them and found that the respondents had only filled out the first six questions of the survey; this provided information on their background and sectors of interest but did not answer any of the substantive questions. It is not clear why respondents submit partial responses, they may have decided that the survey didn't interest them, that it would take too long, or they forgot they started the survey and completed a full response at a different time. As a result, the partial responses are not included in this summary.

Some ***key findings*** from the survey include:

- Respondents are primarily interested in water quality and watershed management, are affiliated with government agencies, have more than 15 years of experience with water resources management issues in the Ohio River basin, deal with these issues on a daily basis, and are responsible for providing input into key planning and management decisions.
- The top two priority issues in the Ohio River basin are water quality and water supply (water supply includes water withdrawals, and management).
- Most respondents have access to the information they need, but it is not adequate or needs improvement. The most common barrier to using the information is that there is not enough information available.
- The primary benefit of providing new or additional information is improved water quality.

The survey results, tabulated by question, are provided in Appendix A. This memorandum summarizes the key findings by topic.

[1] In 2013, ERG performed a similar survey of four river basins in the mid-Atlantic region: Potomac, Delaware, Susquehanna, and Hudson.
[2] While the total response rate appears low at 35 percent, this is consistent with national trends of decreasing response to Web-based surveys.

1 Demographics

Respondents were asked to identify their primary and secondary sectors of interest, affiliation, years of experience in the Ohio River basin and water resources management, the frequency with which they deal with water resources issues, and whether their job entails providing input to strategic planning; program, facility, operations or financial management; or project planning decisions.

The most common primary sectors chosen by respondents were water quality (27 percent), followed by watershed management (16 percent), and fish and wildlife (14 percent). Secondary sectors of interest included water quality (57 percent) and watershed management (58 percent). See Figure 1 and Figure 2.

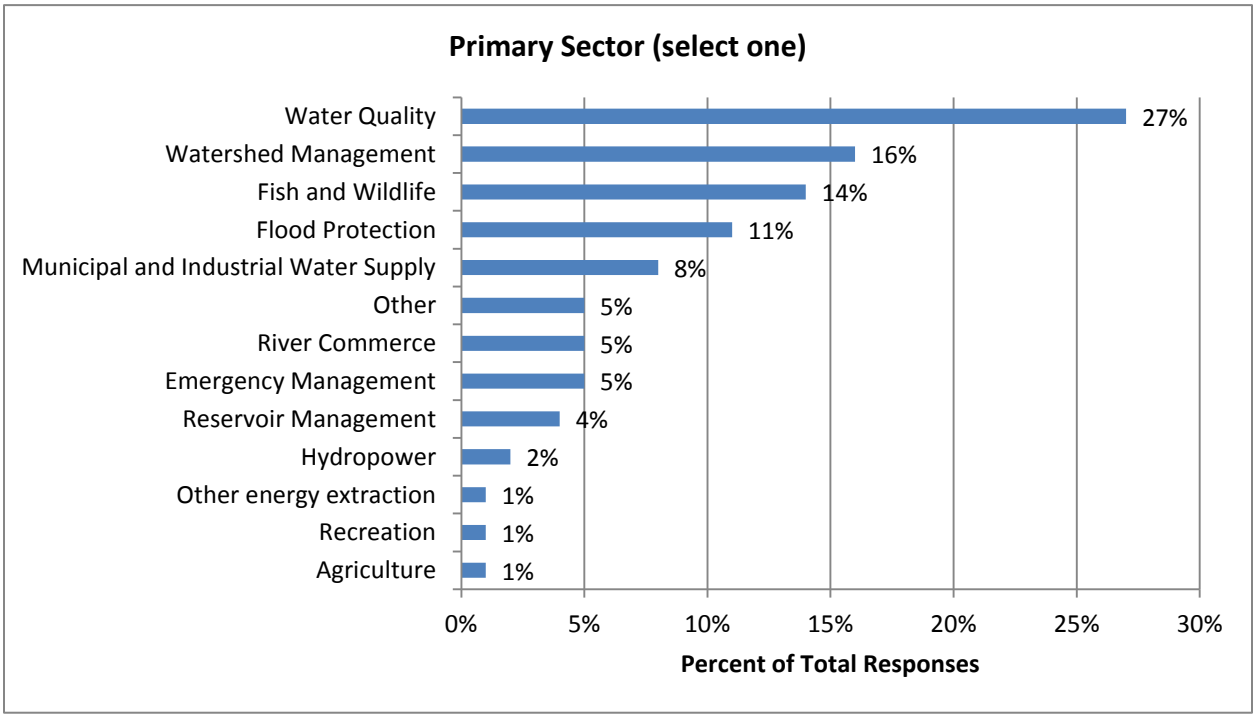


Figure 1: Responses to the question "Please select the PRIMARY sector in which your work or interest is focused."

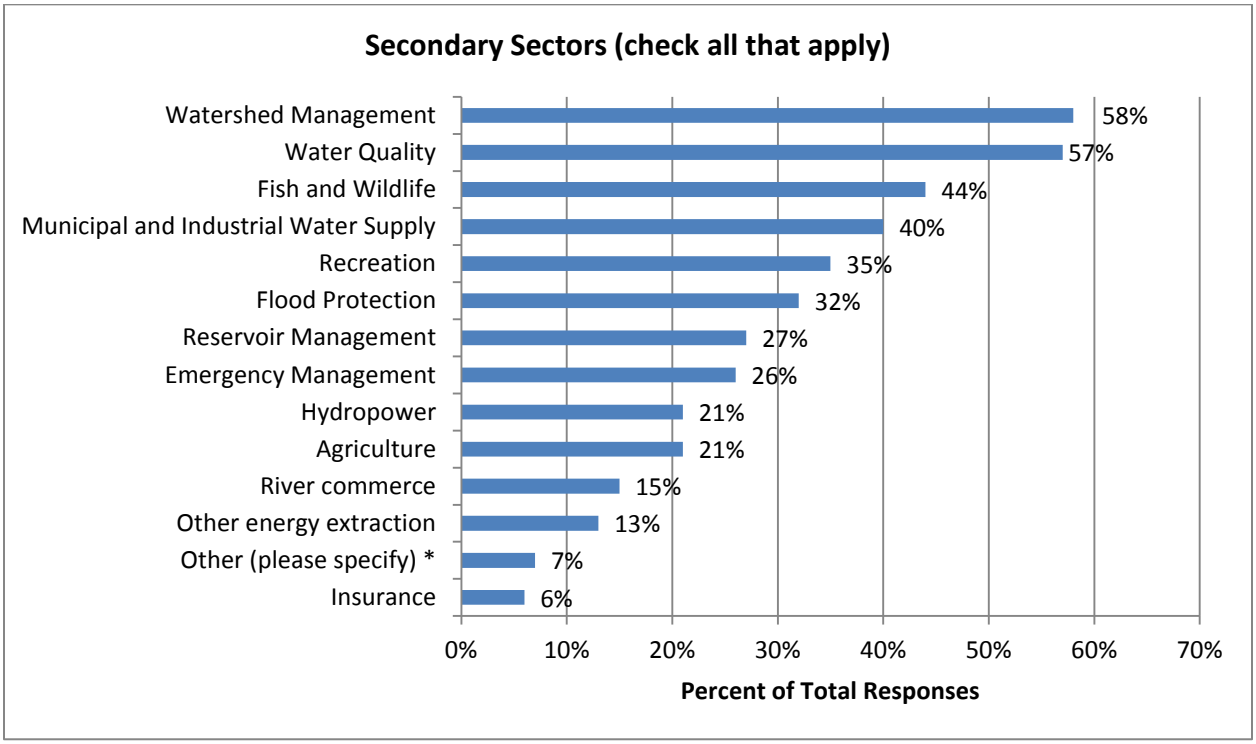


Figure 2: Responses to the question "Please indicate any other sectors in which you work or that you are concerned about (please check all that apply)."

Most respondents (67 percent) are affiliated with federal, state, or local government; of these, the largest group, about one-third of all respondents, is affiliated with state government (31 percent). See Figure 3. The respondents to this survey also have significant experience with water resources issues in the Ohio River basin: 56 percent have more than 15 years experience in this river basin and 68 percent have more than 15 years of experience in water resources management. See Figure 4.

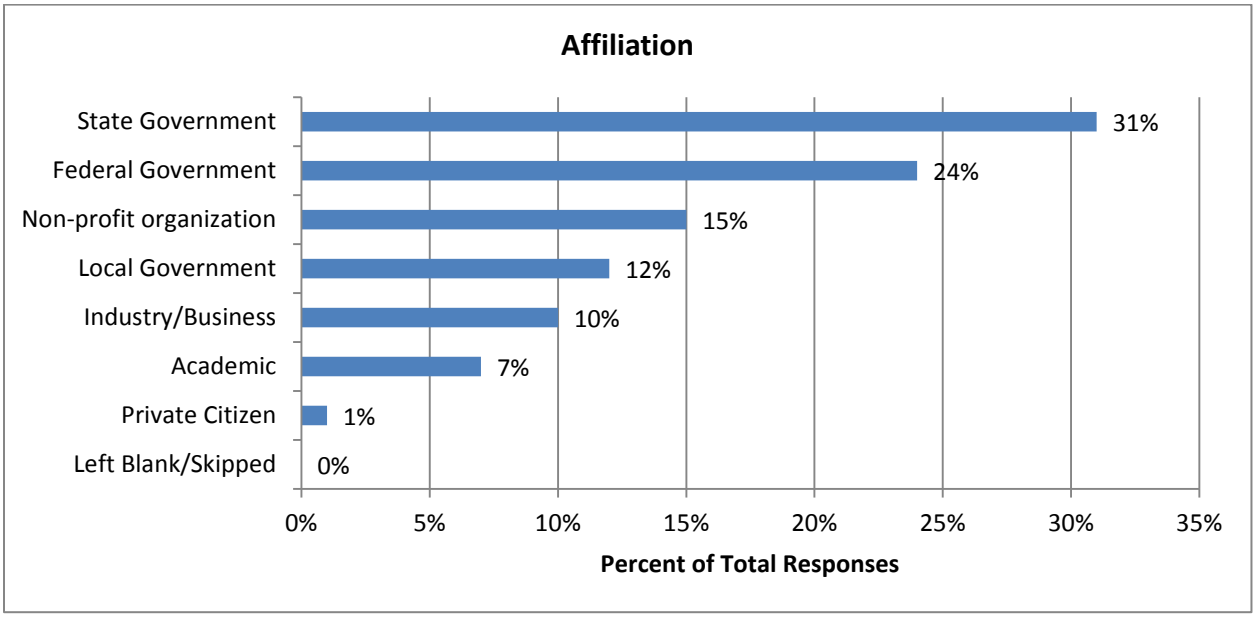


Figure 3: Responses to the question "Please select the affiliation that best describes you work or interest in the Ohio River Basin."

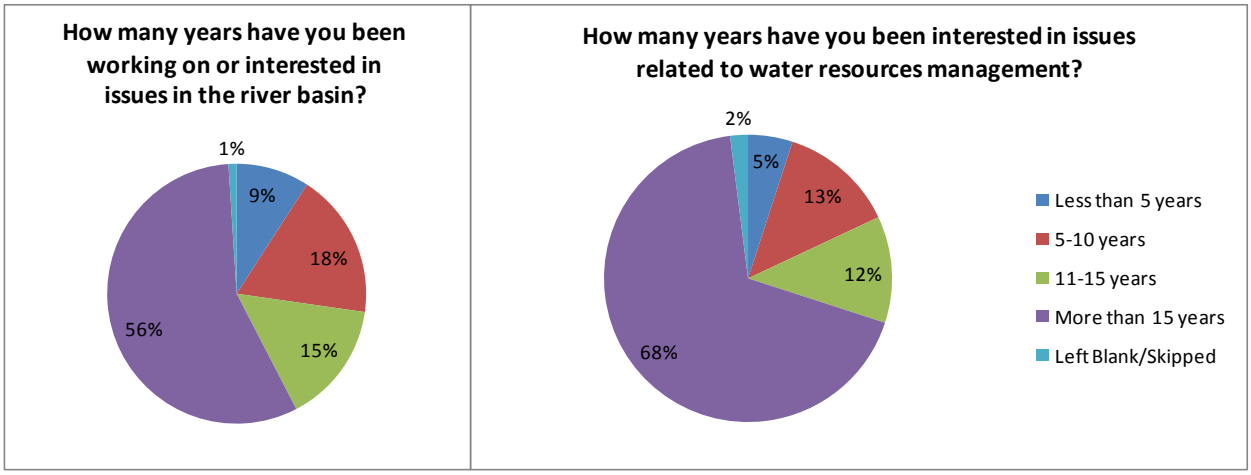


Figure 4: Summary of respondent years of experience with the Ohio River basin and issues related to water resources management.

Further, a majority (63 percent) of the respondents deal with water resources management issues on a daily basis (see Figure 5), and 88 percent have job responsibilities that include providing input to strategic planning; program, facility, operations or financial management; or project planning decisions.

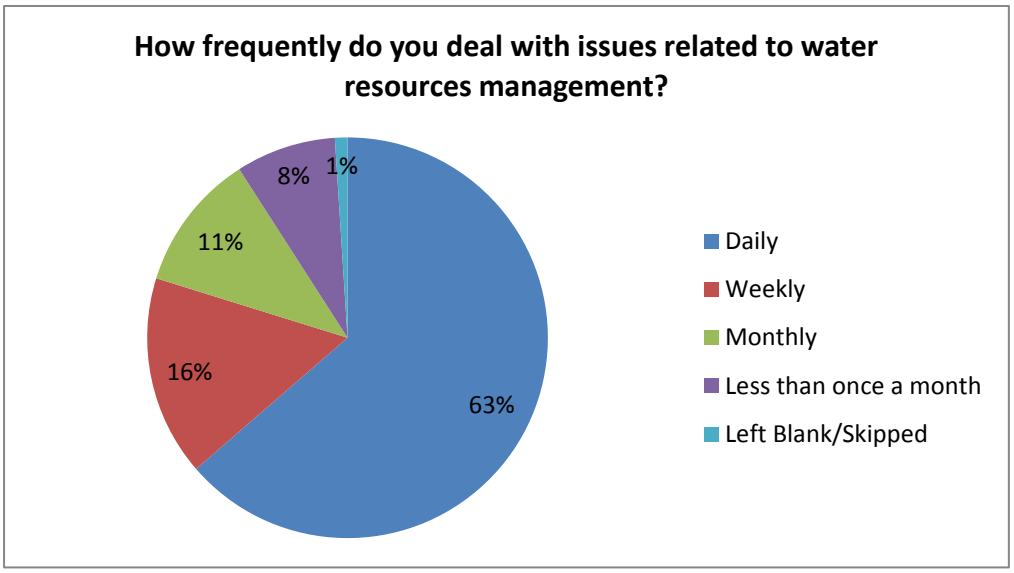


Figure 5: Summary of the frequency with which respondents deal with issues related to water resources management.

2 Priorities

ERG conducted Web-based research and consulted with ORSANCO to identify seven water resources management priority issues facing the basin. The priority issues are summarized in **Error! Reference source not found.**.

Table 1. Ohio River Basin Priority Issues

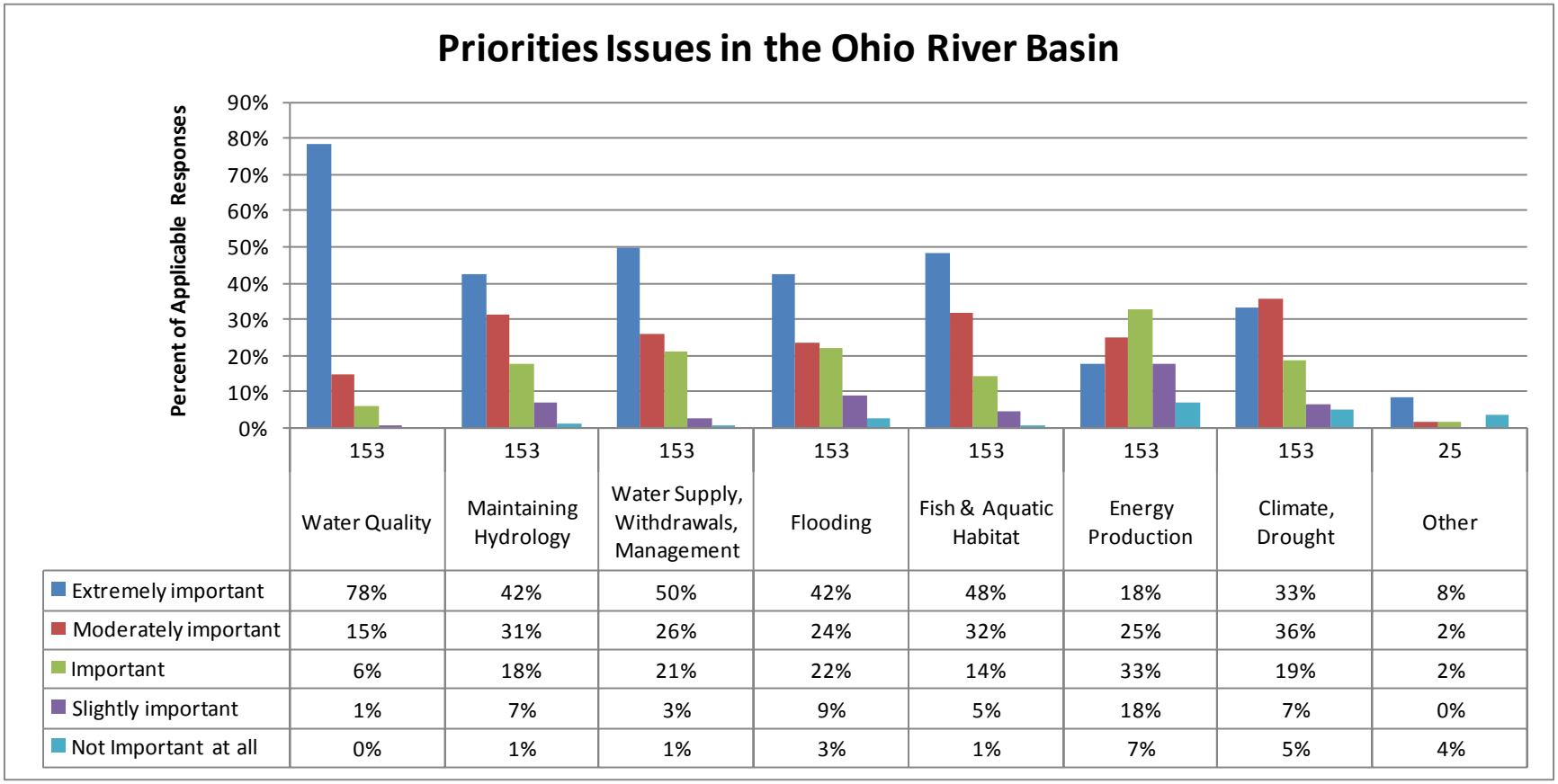
Topic	Issues Include:
Water Quality	• Impacts from runoff by land use conversions and combined sewer overflows • Water quality effects on threatened and endangered species • Pharmaceuticals, bacteria, pesticides, nutrient loading, and sedimentation • Lack of basin stormwater management • Need for water treatment/distribution and sewage collection/treatment infrastructure
Maintaining Hydrology	• Dredging and maintenance of navigation channels is continually needed for commercial navigation. New commodities and freight prospects in the Ohio River place added importance on the navigation system and connections to Gulf Coast ports • Repair and rehabilitation of aging flood control infrastructure is a major concern
Water Supply, Water Withdrawals, Water Management	• Sufficiency of water supplies in view of projected population increases and climate change • Bank erosion due to flow regulation at reservoirs, navigation locks, and dams • Conflicts among water users (i.e., water supply, hydropower, recreation, flood protection, fish and wildlife, and navigation) • Better management of water storage and flows • Out-of-basin water transfers for water supply and other uses
Flooding	• Need for additional flood protection at basin-wide major cities and smaller communities • Need to update floodplain mapping to better manage development • Fiscal sustainability of streamflow gages in the basin that are critical to flood warning systems and drought monitoring
Fish & Aquatic Habitat	• Lack of ecological connectivity between the rivers/floodplains • Regulated flow from reservoirs reduces aquatic species habitat diversity and productivity • Effects of sedimentation on aquatic species including game fish and their food sources • Invasive species effects on indigenous aquatic and terrestrial species in the basin • Changes to river flow regimes, temperature and nutrient dynamics of the river system has affected some fisheries
Energy Production	• Water quality and quantity impacts associated with exploration of the Marcellus shale • Concerns about impacts of transporting fracking wastes along Ohio River and other waterways • Hydropower facilities' impact on aquatic life by causing mortality to fish that pass through the facility's turbines • Diversion of river flow through a hydropower facility
Climate/Drought	• Potential effects of climate change on threatened and endangered species habitat, recreational use, water supplies and agriculture.

Respondents were asked to rate each of the priorities on a scale from 1 to 5, where 1 is "Not Important at All," 2 is "Slightly Important," 3 is "Important," 4 is "Moderately Important," and 5 is "Extremely Important," and then identify their top three issues across all seven priorities. Looking across priority issues, respondents were most likely to rate water quality as being extremely important (78 percent). The next most important issues, in terms of the percent of respondents that

rated them extremely important, were water supply, withdrawals and management (50 percent) and fish and aquatic habitat (48 percent). See Figure 6.

Looking at each priority issue, respondents tended to rate issues as extremely or moderately important; fewer than 10 percent of respondents rated any particular issue as not important at all. For example, for water quality, maintaining hydrology, water supply, flooding, and fish and aquatic habitat over 40 percent of respondents rated the issue as extremely important. For the remaining two issues, about one-third of respondents rated climate/drought as moderately important (a "4" on the five-point scale), while roughly the same amount rated energy production as important only (a "3" on the five-point scale).

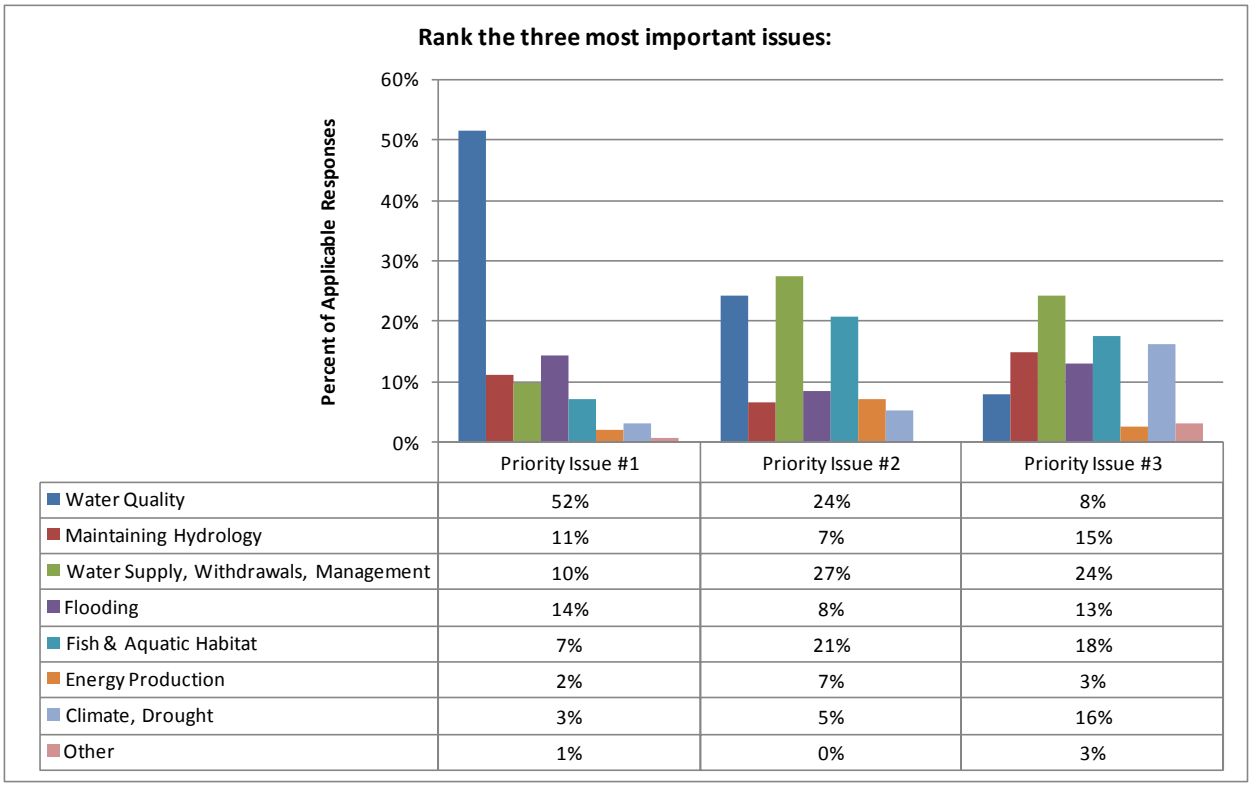
Respondents also suggested other priority issues that were not on the list, including: invasive aquatic species, recreational uses, and outreach and education. A complete list of other issues is provided in the Appendix.



	153 Water Quality	153 Maintaining Hydrology	153 Water Supply, Withdrawals, Management	153 Flooding	153 Fish & Aquatic Habitat	153 Energy Production	153 Climate, Drought	25 Other
Extremely important	78%	42%	50%	42%	48%	18%	33%	8%
Moderately important	15%	31%	26%	24%	32%	25%	36%	2%
Important	6%	18%	21%	22%	14%	33%	19%	2%
Slightly important	1%	7%	3%	9%	5%	18%	7%	0%
Not Important at all	0%	1%	1%	3%	1%	7%	5%	4%

Figure 6: Summary of respondent ratings of seven priority issues in the Ohio River basin.

The respondents also ranked their top three most important issues, in order of importance where 1 indicates the most important issue. Consistent with the results above, 52 percent of respondents selected water quality as the most important issue. Water supply was the most likely priority to be selected as the #2 and # 3 priority issues. See Figure 7.



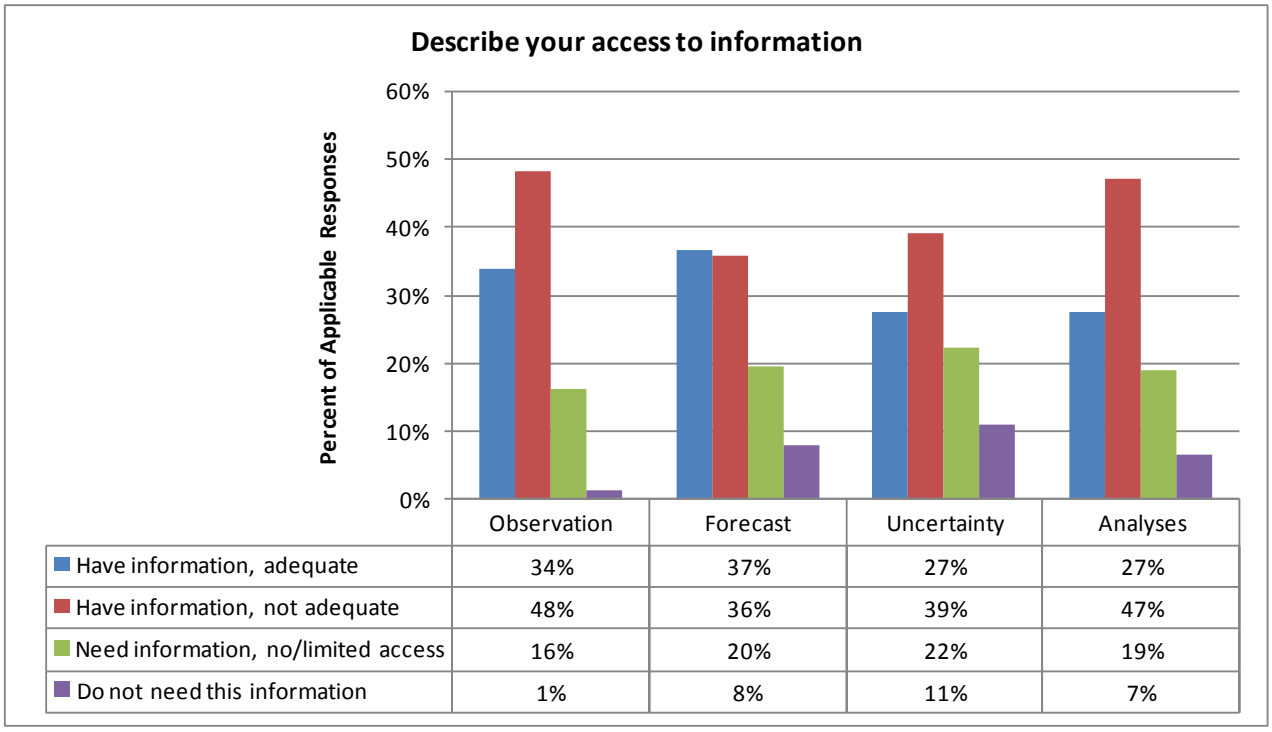
	Priority Issue #1	Priority Issue #2	Priority Issue #3
Water Quality	52%	24%	8%
Maintaining Hydrology	11%	7%	15%
Water Supply, Withdrawals, Management	10%	27%	24%
Flooding	14%	8%	13%
Fish & Aquatic Habitat	7%	21%	18%
Energy Production	2%	7%	3%
Climate, Drought	3%	5%	16%
Other	1%	0%	3%

Figure 7: Respondent ratings of the top three most important priority issues.

3 Access to and Use of information

Respondents described their access to four types of water resources information: observations, forecasts, uncertainties, and analyses. For each of those four types of information, respondents were asked to describe the timeline for decision making based on the information, their preferred timing for information updates, and barriers to use.

Overall, most respondents indicated that they have access to the information, but for many of them the information is not adequate or needs improvement. For example, 82 percent of respondents have access to observations, but 48 percent indicate that the information needs improvement. See Figure 8.



	Observation	Forecast	Uncertainty	Analyses
Have information, adequate	34%	37%	27%	27%
Have information, not adequate	48%	36%	39%	47%
Need information, no/limited access	16%	20%	22%	19%
Do not need this information	1%	8%	11%	7%

Figure 8: Summary of respondent access to observations, forecasts, uncertainty information, and analyses.

3.1 Observations

Respondents are using observation information to support decision making over a wide range of time frames from immediate (30 percent) to over 1 year (36 percent). See Figure 9. One third of respondents would like to see new observation information made available for use on an hourly basis (see Figure 10).

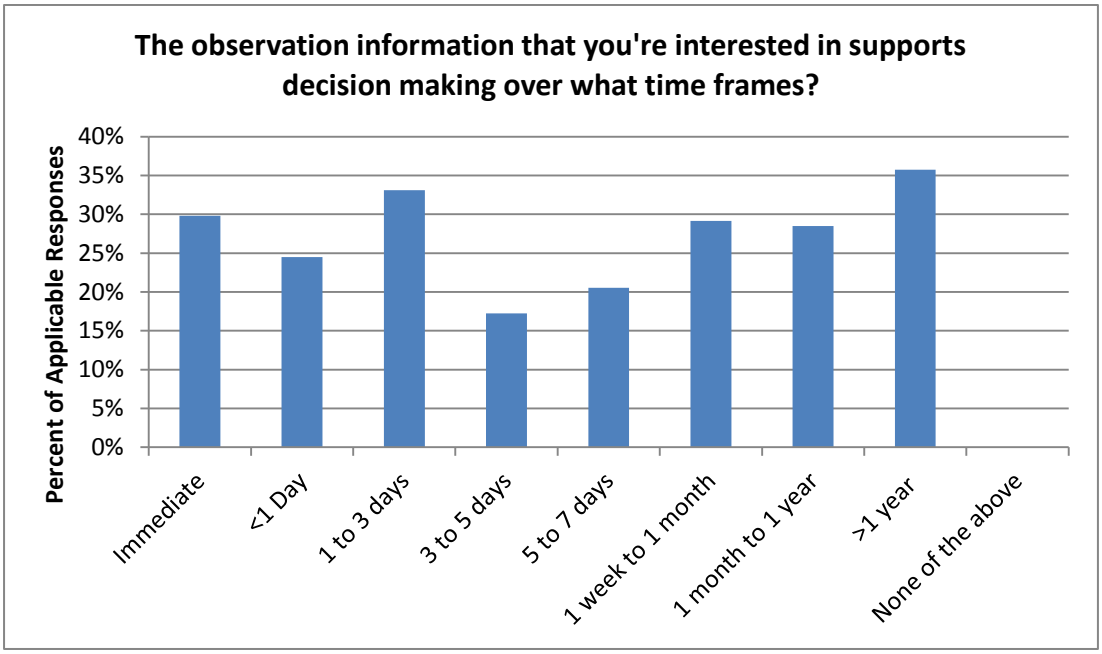


Figure 9: Summary of respondent use of observation information for decision-making.

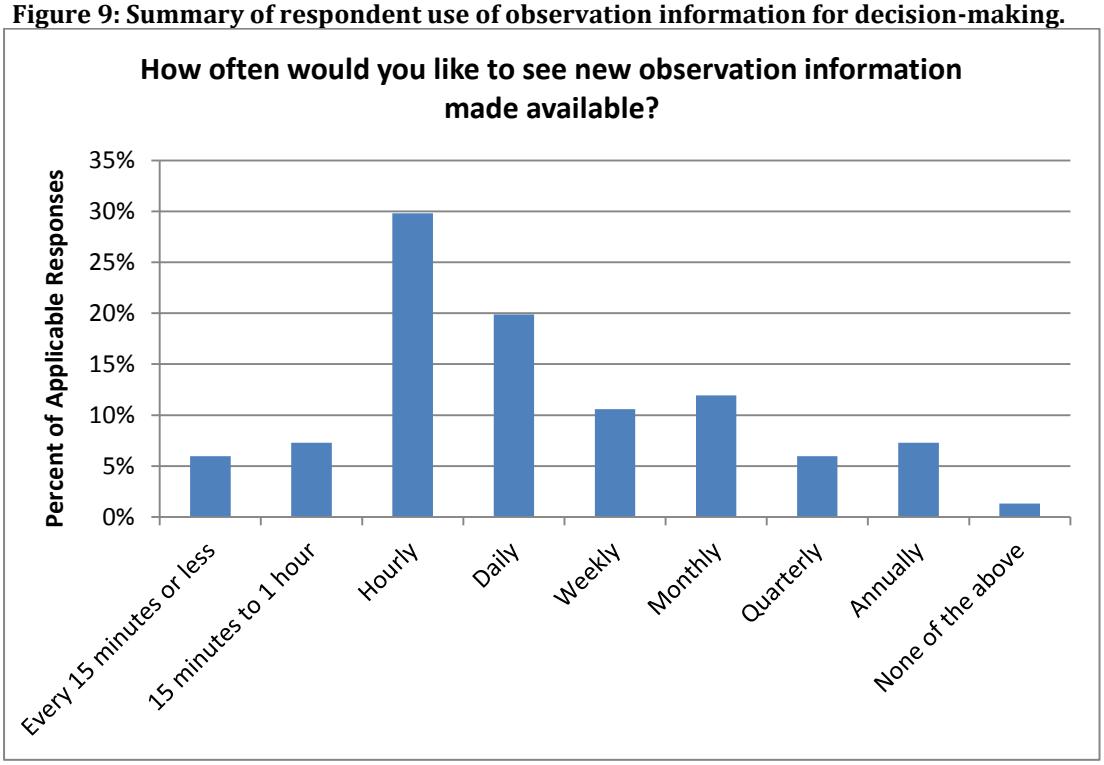
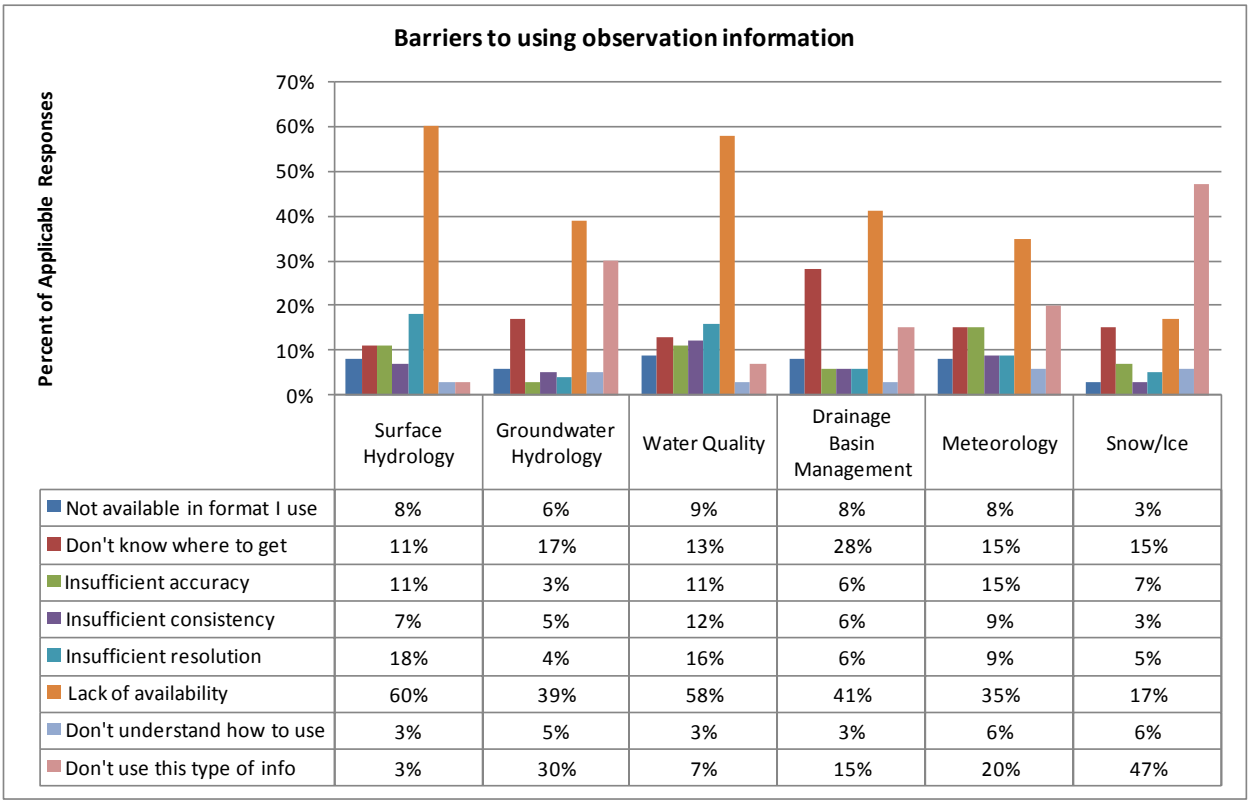


Figure 10: Summary of desired frequency of observation information updates.

Respondents that indicated that a particular type of information is unavailable or needs improvement were asked to describe the current barriers to using the information. For observation information, the most common barrier to use was lack of information available on surface hydrology (60 percent), water quality (58 percent), drainage basin management (41 percent), groundwater hydrology (39 percent), meteorology (35 percent), and snow/ice (17 percent); note, however, 47 percent do not use snow/ice melt information. See Figure 11.



	Surface Hydrology	Groundwater Hydrology	Water Quality	Drainage Basin Management	Meteorology	Snow/Ice
Not available in format I use	8%	6%	9%	8%	8%	3%
Don't know where to get	11%	17%	13%	28%	15%	15%
Insufficient accuracy	11%	3%	11%	6%	15%	7%
Insufficient consistency	7%	5%	12%	6%	9%	3%
Insufficient resolution	18%	4%	16%	6%	9%	5%
Lack of availability	60%	39%	58%	41%	35%	17%
Don't understand how to use	3%	5%	3%	3%	6%	6%
Don't use this type of info	3%	30%	7%	15%	20%	47%

Figure 11: Responses to the question "What are some of the barriers to using the following types of observation information."

3.2 Forecasts

Most respondents indicated they are using forecast information to make decisions over a time frame of 1-to-3 days (36 percent) followed by a time frame of over 1 year (28 percent). See Figure 12. Thirty-two percent would like to see new forecast information made available for use daily followed by hourly (25 percent). See Figure 13.

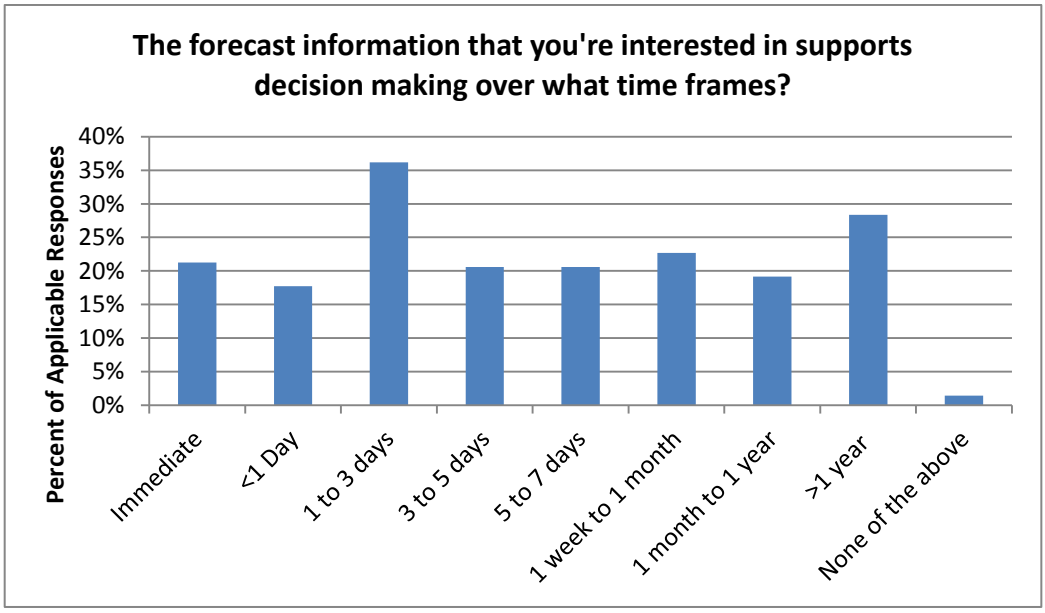


Figure 12: Summary of respondent use of forecast information for decision-making.

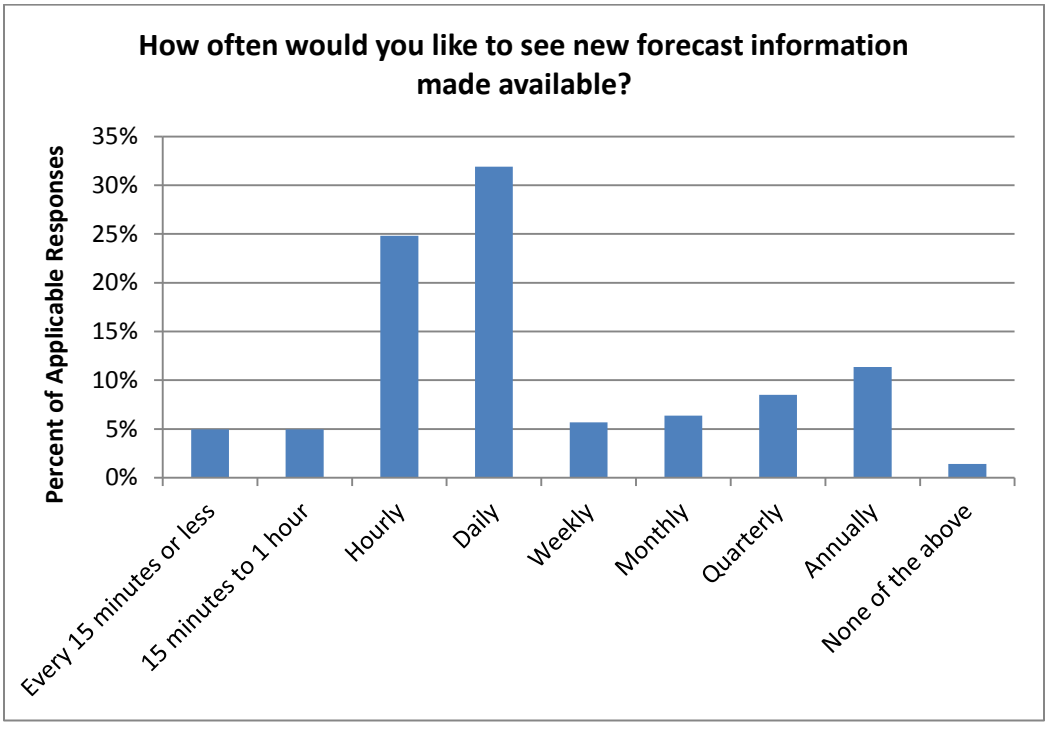
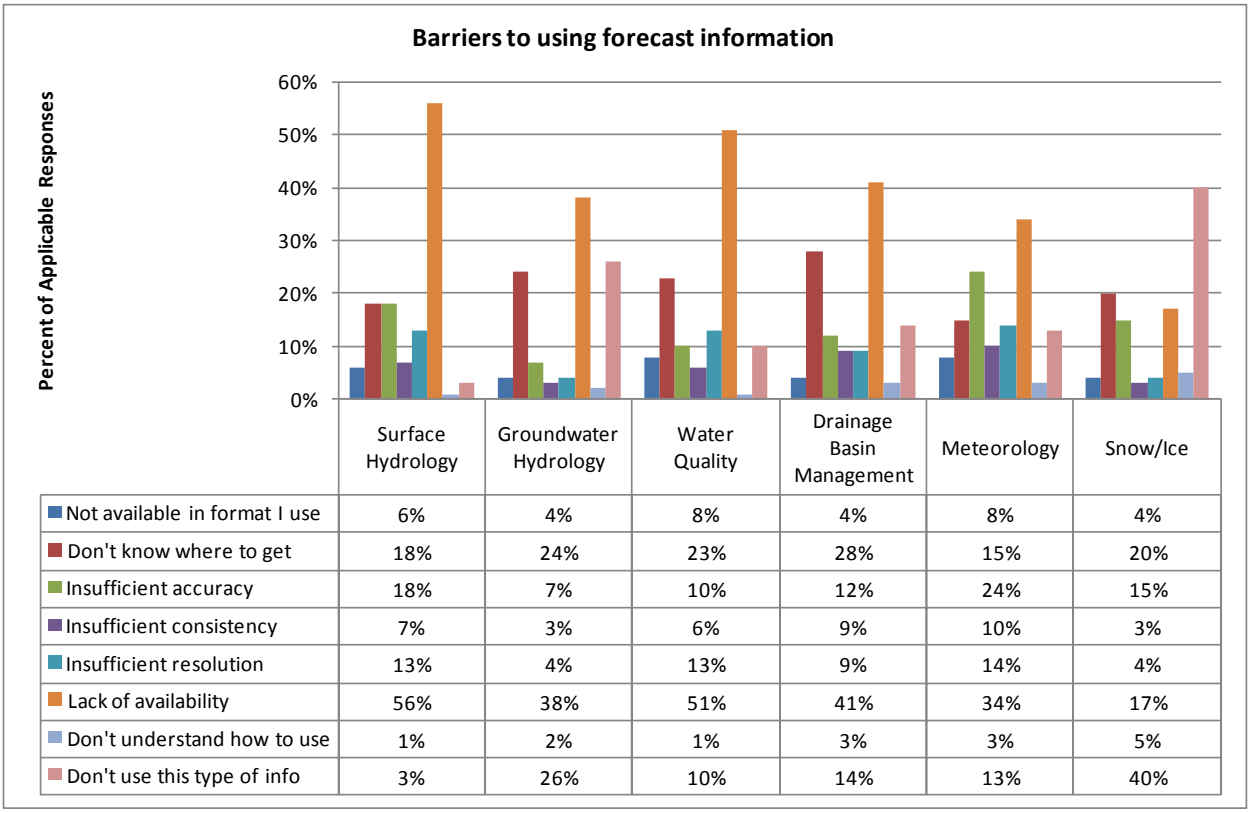


Figure 13: Summary of desired frequency of forecast information updates.

Respondents who indicated that a particular type of information is unavailable or needs improvement were asked to describe the current barriers to using the information. For forecast information, the most common barrier cited was lack of available information for surface hydrology (56 percent), water quality (51 percent), drainage basin management (41 percent), groundwater hydrology (38 percent), meteorology (34 percent), and snow/ice (17 percent; note, however that 40 percent do not use snow/ice melt information). Other common barriers included not knowing where to get the information and perceived insufficient accuracy of the information. See Figure 14.



	Surface Hydrology	Groundwater Hydrology	Water Quality	Drainage Basin Management	Meteorology	Snow/Ice
Not available in format I use	6%	4%	8%	4%	8%	4%
Don't know where to get	18%	24%	23%	28%	15%	20%
Insufficient accuracy	18%	7%	10%	12%	24%	15%
Insufficient consistency	7%	3%	6%	9%	10%	3%
Insufficient resolution	13%	4%	13%	9%	14%	4%
Lack of availability	56%	38%	51%	41%	34%	17%
Don't understand how to use	1%	2%	1%	3%	3%	5%
Don't use this type of info	3%	26%	10%	14%	13%	40%

Figure 14: Responses to the question "What are some of the barriers to using the following types of forecast information."

3.3 Uncertainties

For many respondents, uncertainty information supports decision making over a longer timeline, either more than a year (34 percent) or 1-month-to-1-year (25 percent). However, a significant percentage of respondents also work with shorter time frames, such as 1-to-3 days (24 percent). See Figure 15. Respondents would like to see new uncertainty information made available daily (29 percent) or annually (21 percent). See Figure 16.

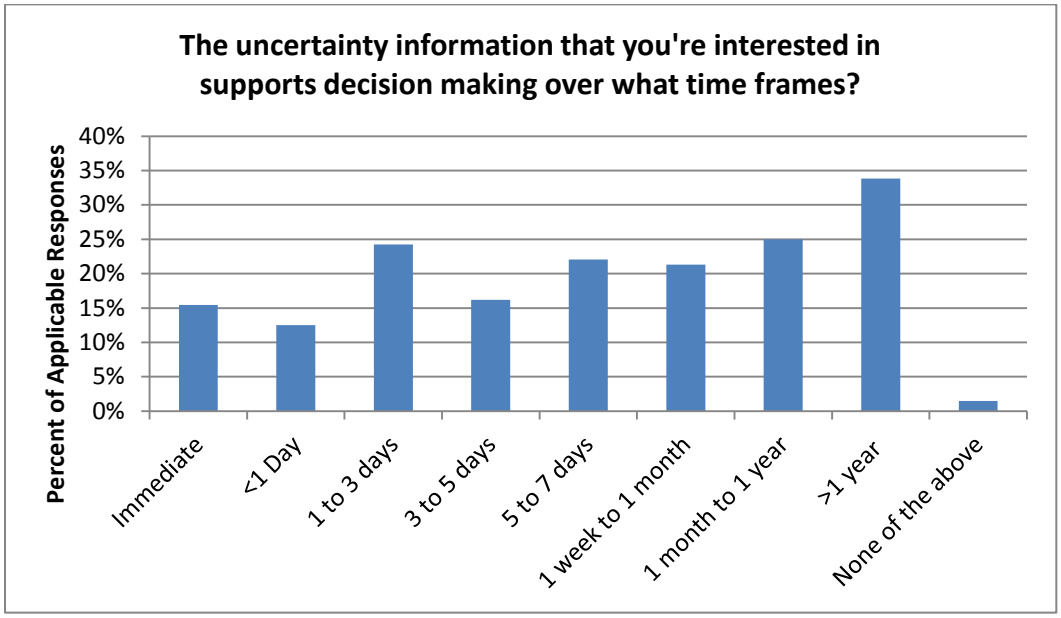


Figure 15: Summary of respondent use of uncertainty information for decision-making.

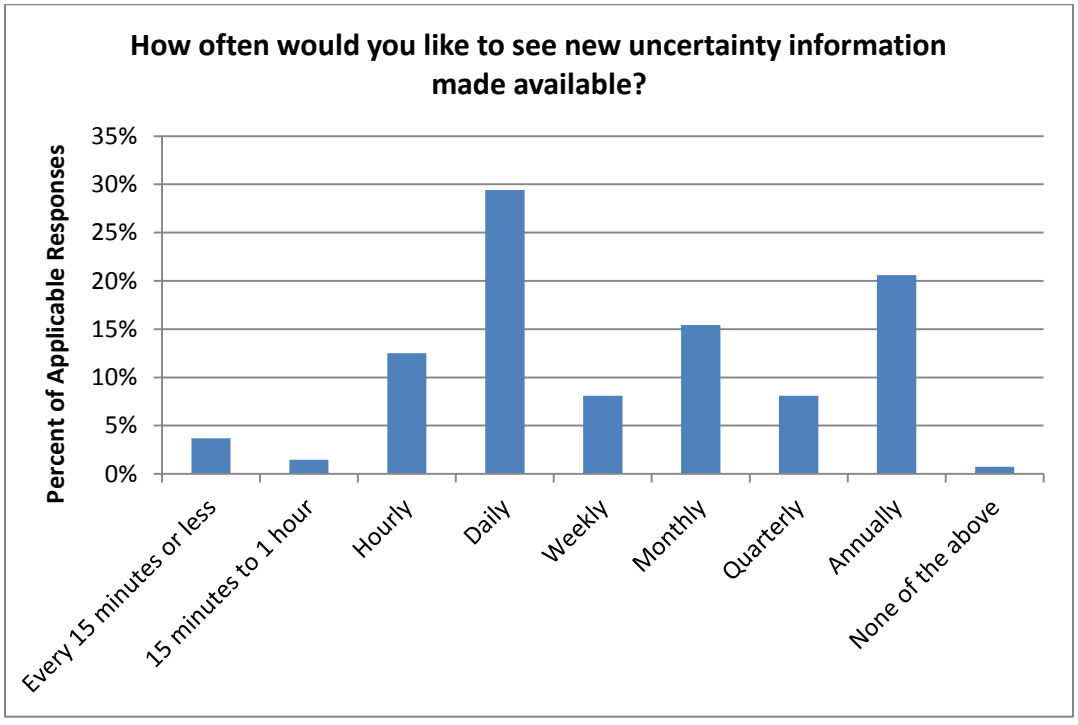
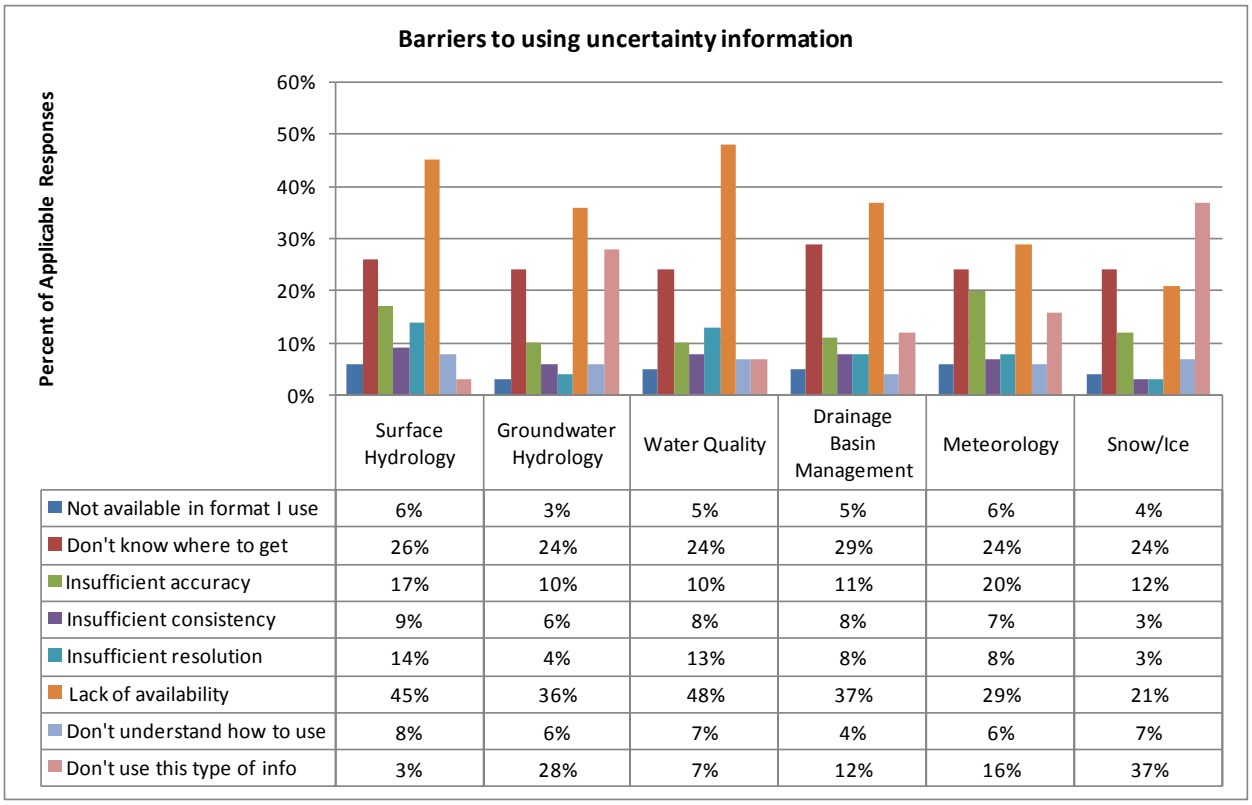


Figure 16: Summary of desired frequency of uncertainty information updates.

Respondents that indicated that a particular type of information is unavailable or needs improvement were asked to describe the current barriers to using the information. For uncertainty information, the most common barrier to use is that there isn't enough information available for surface hydrology (45 percent), water quality (48 percent), drainage basin management (37 percent), groundwater hydrology (36 percent), and meteorology (29 percent). The other key barrier for many of these information types is that respondents do not know where to get the information. See Figure 17.



	Surface Hydrology	Groundwater Hydrology	Water Quality	Drainage Basin Management	Meteorology	Snow/Ice
Not available in format I use	6%	3%	5%	5%	6%	4%
Don't know where to get	26%	24%	24%	29%	24%	24%
Insufficient accuracy	17%	10%	10%	11%	20%	12%
Insufficient consistency	9%	6%	8%	8%	7%	3%
Insufficient resolution	14%	4%	13%	8%	8%	3%
Lack of availability	45%	36%	48%	37%	29%	21%
Don't understand how to use	8%	6%	7%	4%	6%	7%
Don't use this type of info	3%	28%	7%	12%	16%	37%

Figure 17: Responses to the question "What are some of the barriers to using the following types of uncertainty information."

When asked if their organization has a formal mechanism or decision model that uses uncertainty information, 41 percent of respondents replied "no," but 22 percent indicated that their organization uses a qualitative approach and 22 percent indicated that their organization has a formal mechanism in place. Those using a qualitative approach described the approach in terms of providing a range of possibilities for forecasts, defining a best case or worst case scenario, or determining how concerned to be about a long term forecast. Those using a formal model described statistical models for risk and uncertainty as well as in-house analyses of water withdrawals or drought forecasting. Full responses to this question are provided in the Appendix; see question 17b.

3.4 Analyses

For 36 percent of respondents, analyses support decisions made over a timeline of more than a year; see Figure 18. Another 30 percent of respondents need analyses to support decisions over a time frame of 1-to-3 days, and 29 percent need analyses to support decisions made over a 1-month-to-1-year time frame. Respondents would like to see new analyses made available hourly (20 percent), daily (17 percent) or annually (17 percent), see Figure 19.

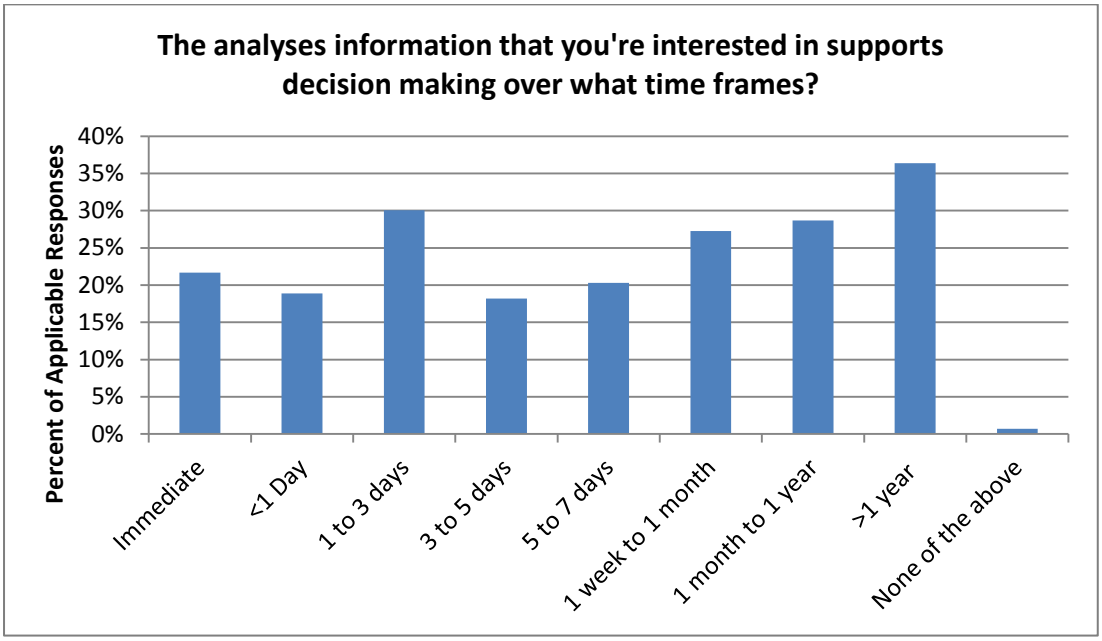


Figure 18: Summary of respondent use of analyses for decision-making.

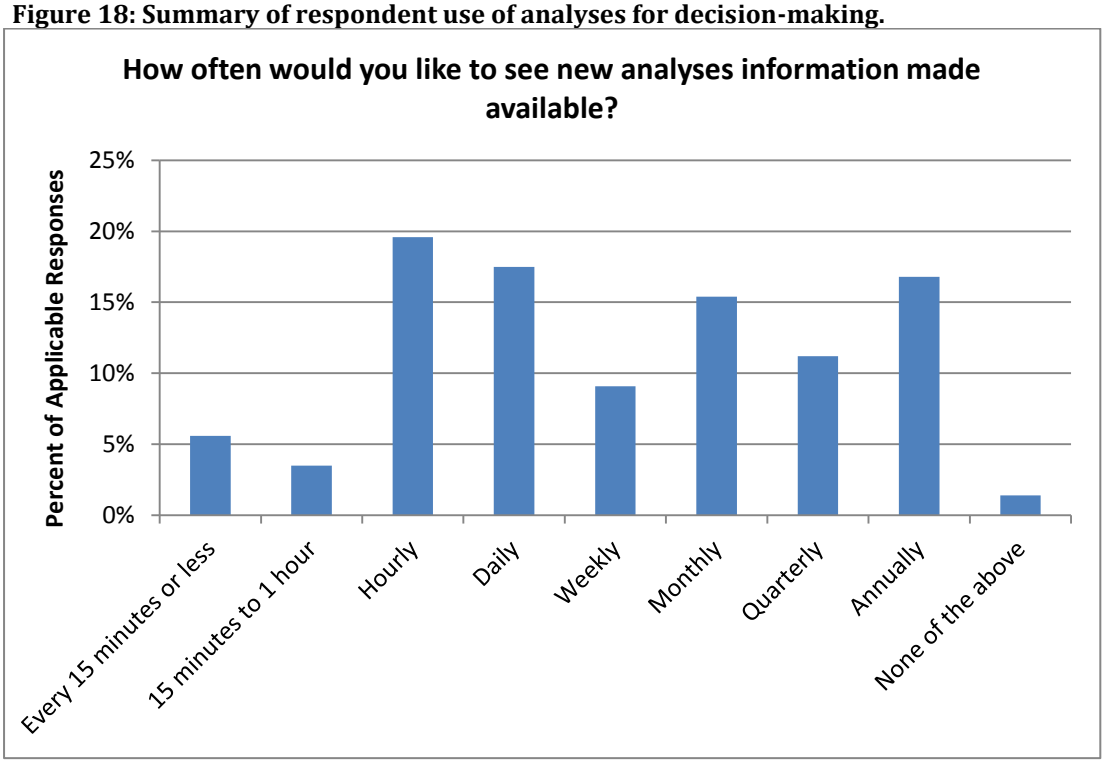
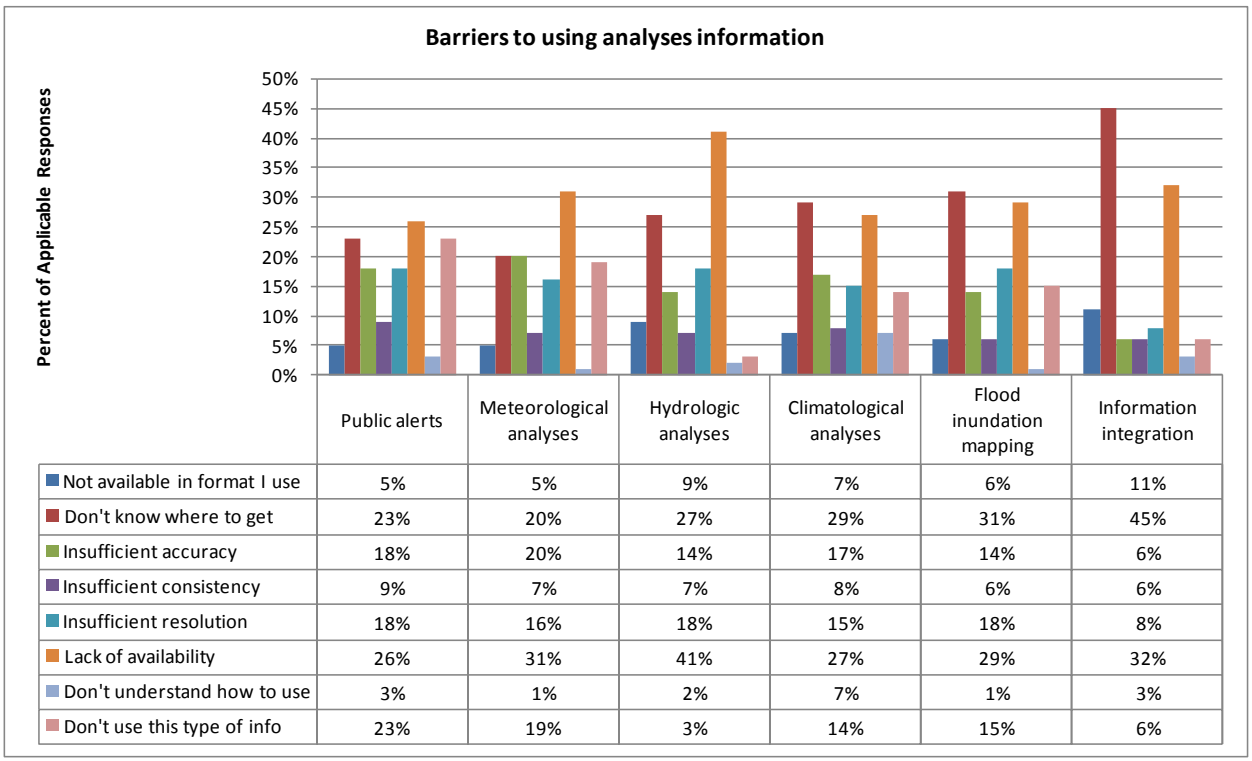


Figure 19: Summary of desired frequency of uncertainty information updates.

Consistent with the above findings, a key barrier to use of analyses was lack of information available, particularly for hydrologic analyses (41 percent), meteorological analyses (31 percent), and public alerts (26 percent). For most of these analyses, not knowing where to get the information was a key barrier to use, particularly for information integration (45 percent), flood inundation mapping (31 percent) and climatological analyses (29 percent). See Figure 20.



	Public alerts	Meteorological analyses	Hydrologic analyses	Climatological analyses	Flood inundation mapping	Information integration
Not available in format I use	5%	5%	9%	7%	6%	11%
Don't know where to get	23%	20%	27%	29%	31%	45%
Insufficient accuracy	18%	20%	14%	17%	14%	6%
Insufficient consistency	9%	7%	7%	8%	6%	6%
Insufficient resolution	18%	16%	18%	15%	18%	8%
Lack of availability	26%	31%	41%	27%	29%	32%
Don't understand how to use	3%	1%	2%	7%	1%	3%
Don't use this type of info	23%	19%	3%	14%	15%	6%

Figure 20: Responses to the question "What are some of the barriers to using the following types of analyses."

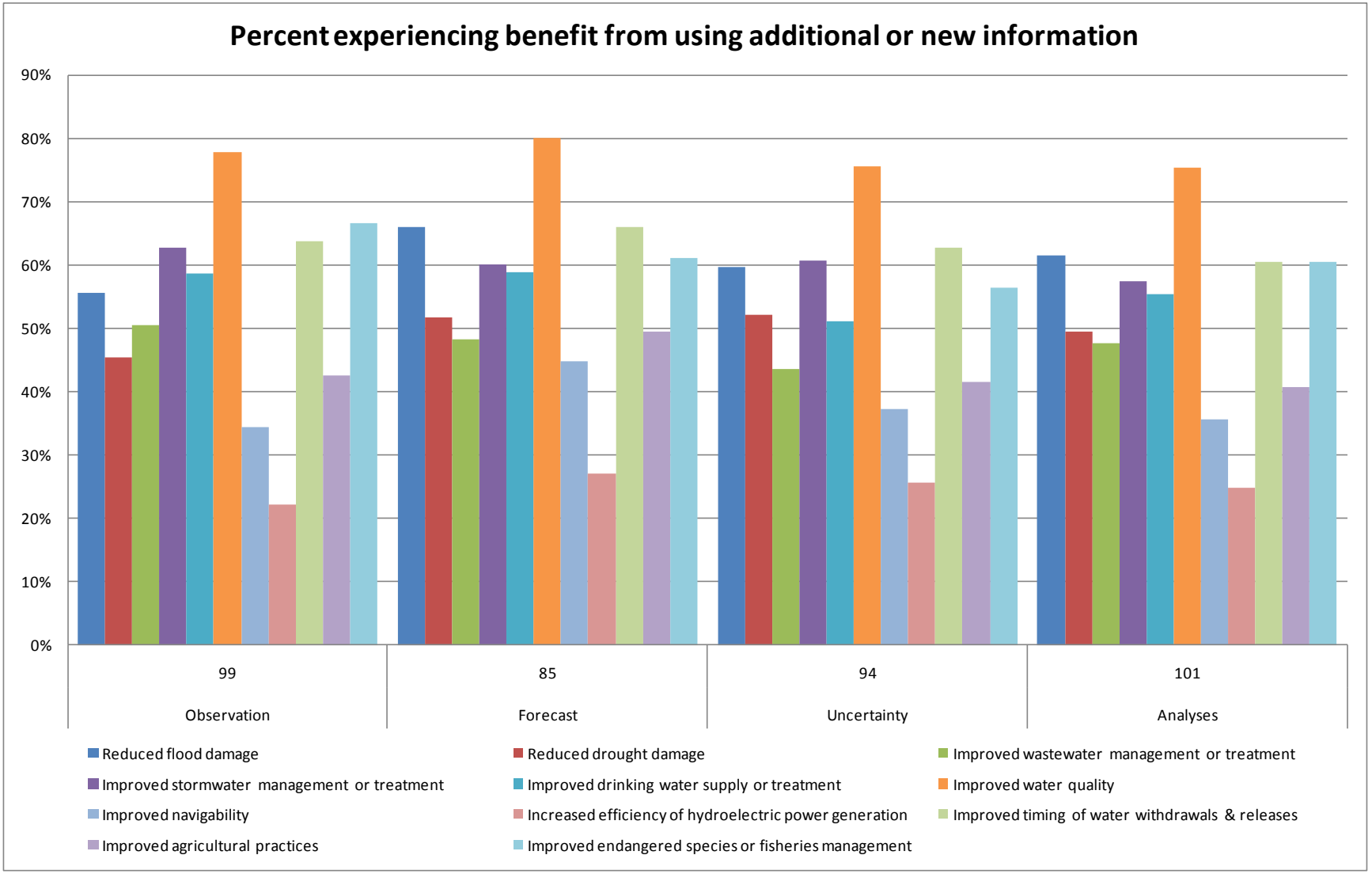
4 Benefits of Filling Information Gaps

For each of the four types of information (observation, forecasts, uncertainty, and analyses) respondents were asked whether they would experience any of ten potential benefits from using additional or new water resources information. The potential benefits included:

- Reduced flood damage (property damage, injury or loss of life, lost business, recovery costs)
- Reduced drought damage
- Improved wastewater management or treatment
- Improved stormwater management or treatment
- Improved drinking water supply or treatment
- Improved water quality
- Improved navigability (shipping, recreation)
- Increased efficiency of hydroelectric power generation
- Improved timing of water withdrawals and releases or its management
- Improved agricultural practices
- Improved endangered/threaten species or fisheries management

Note: The number above each information type represents the total number of respondents anticipating potential benefits of new or additional information of that type.

Figure 21 provides an overview of the benefits of new or additional information for observations, forecasts, uncertainty information, and analyses. Improved water quality was the most prominent benefit across the four categories.



Note: The number above each information type represents the total number of respondents anticipating potential benefits of new or additional information of that type.

Figure 21: Summary of potential benefits of new or additional information for observations, forecasts, uncertainty information, and analyses.

4.1 Observations

Respondents indicated that the top three potential benefits of providing new or additional observation information were improved water quality (77 percent), improved management of endangered species or fisheries (66 percent), improved timing of water withdrawals, releases and management (63 percent), and improved stormwater management (62 percent). See Figure 22.

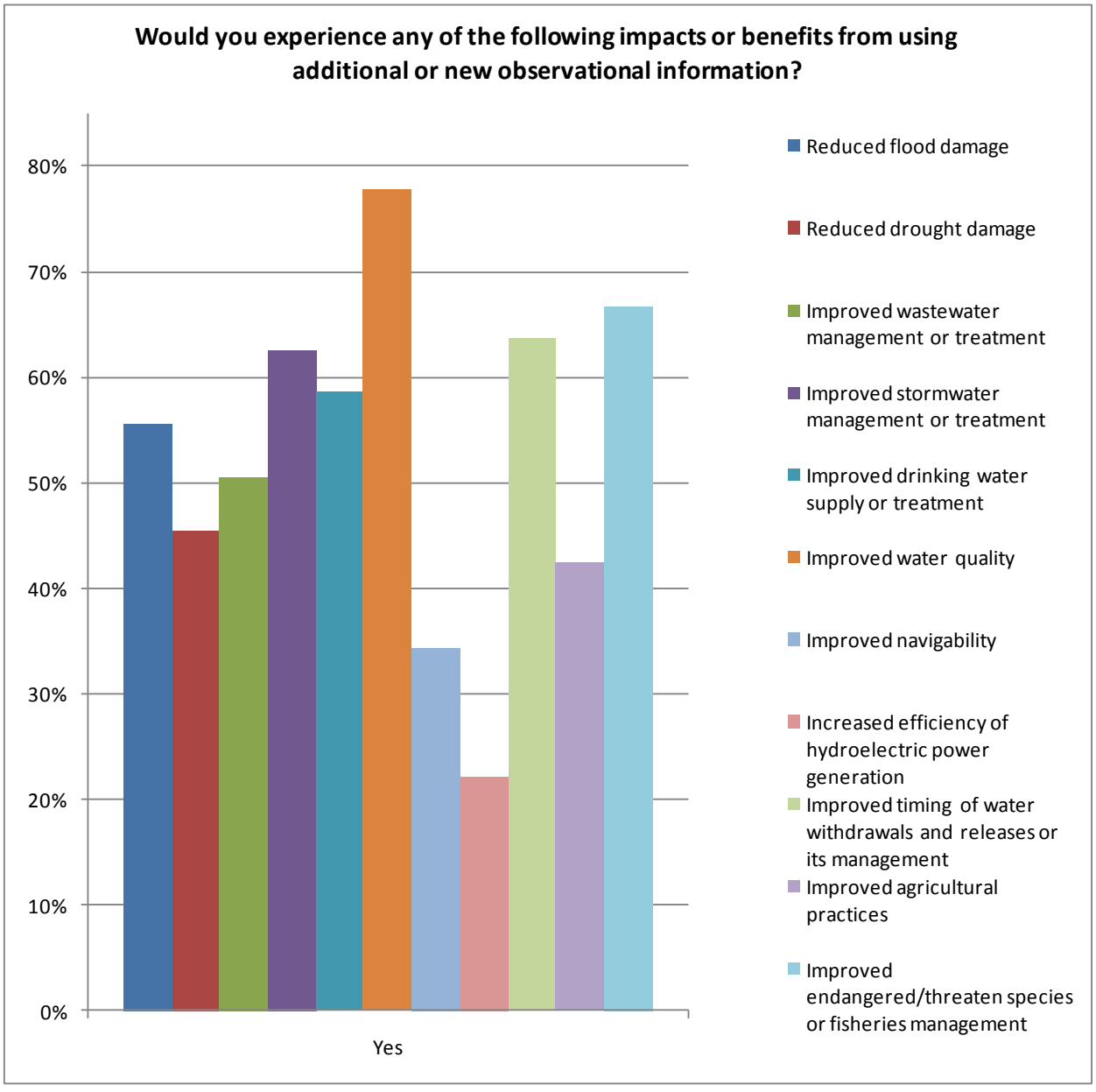


Figure 22: Summary of benefits of using new or additional observation information.

4.2 Forecasts

Respondents identified the top three potential benefits of providing new or additional forecast information as improved water quality (68 percent), reduced flood damage (56 percent), and improved timing of water withdrawals, releases and management (56 percent). See Figure 23.

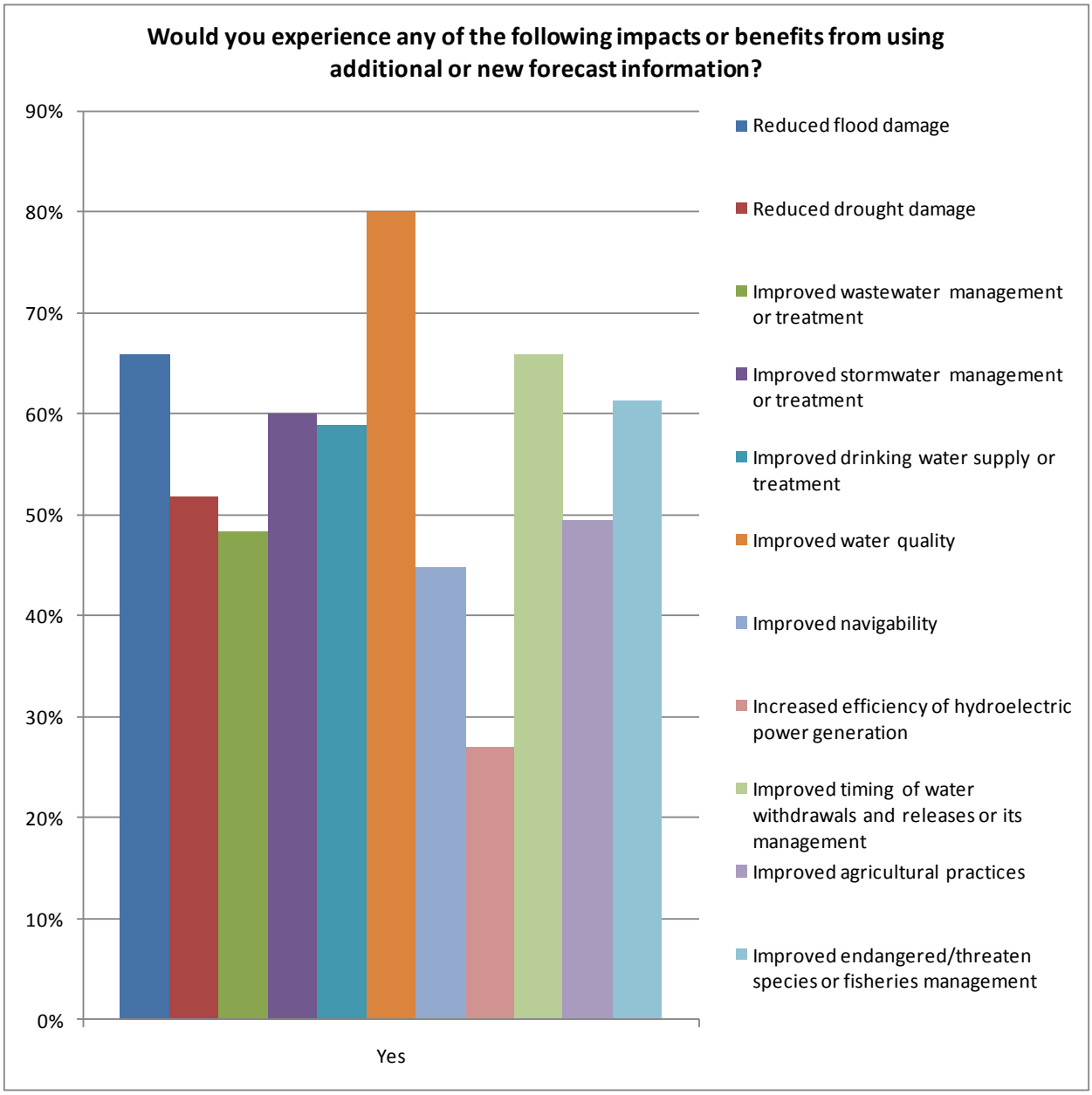


Figure 23: Summary of benefits of using new or additional forecast information.

4.3 Uncertainties

The top three potential benefits of providing new or additional uncertainty information was improved water quality (71 percent), improved timing of water withdrawals, releases and management (59 percent), improved stormwater management (57 percent), and reduced flood damage (56 percent). See Figure 24.

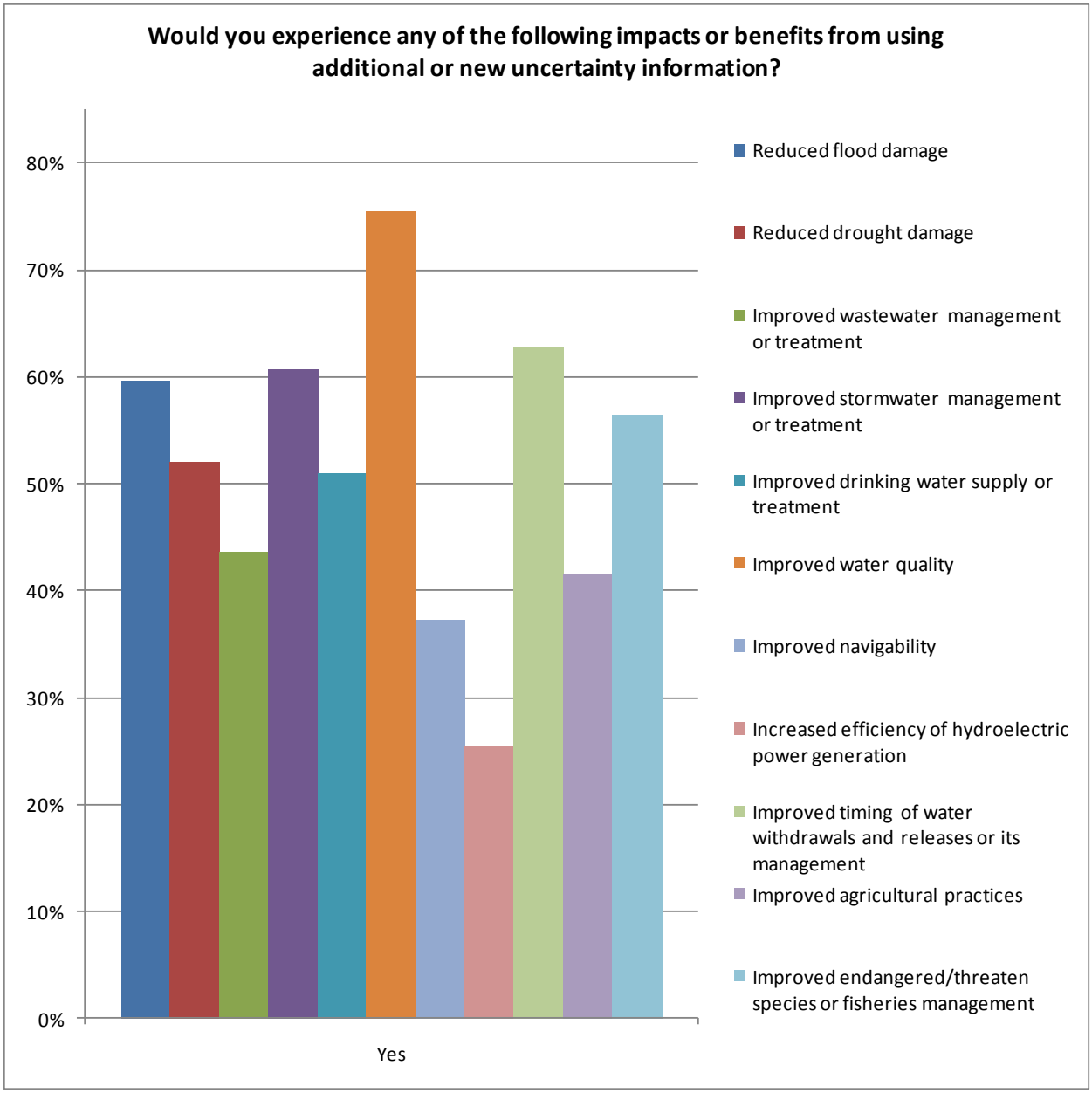


Figure 24: Summary of benefits of using new or additional uncertainty information.

4.4 Analyses

Respondents indicated that the top three potential benefits of providing new or additional analyses were improved water quality (76 percent), reduced flood damage (62 percent), improved timing of water withdrawals, releases and management (61 percent), and improved endangered species or fisheries management (61 percent). See Figure 25.

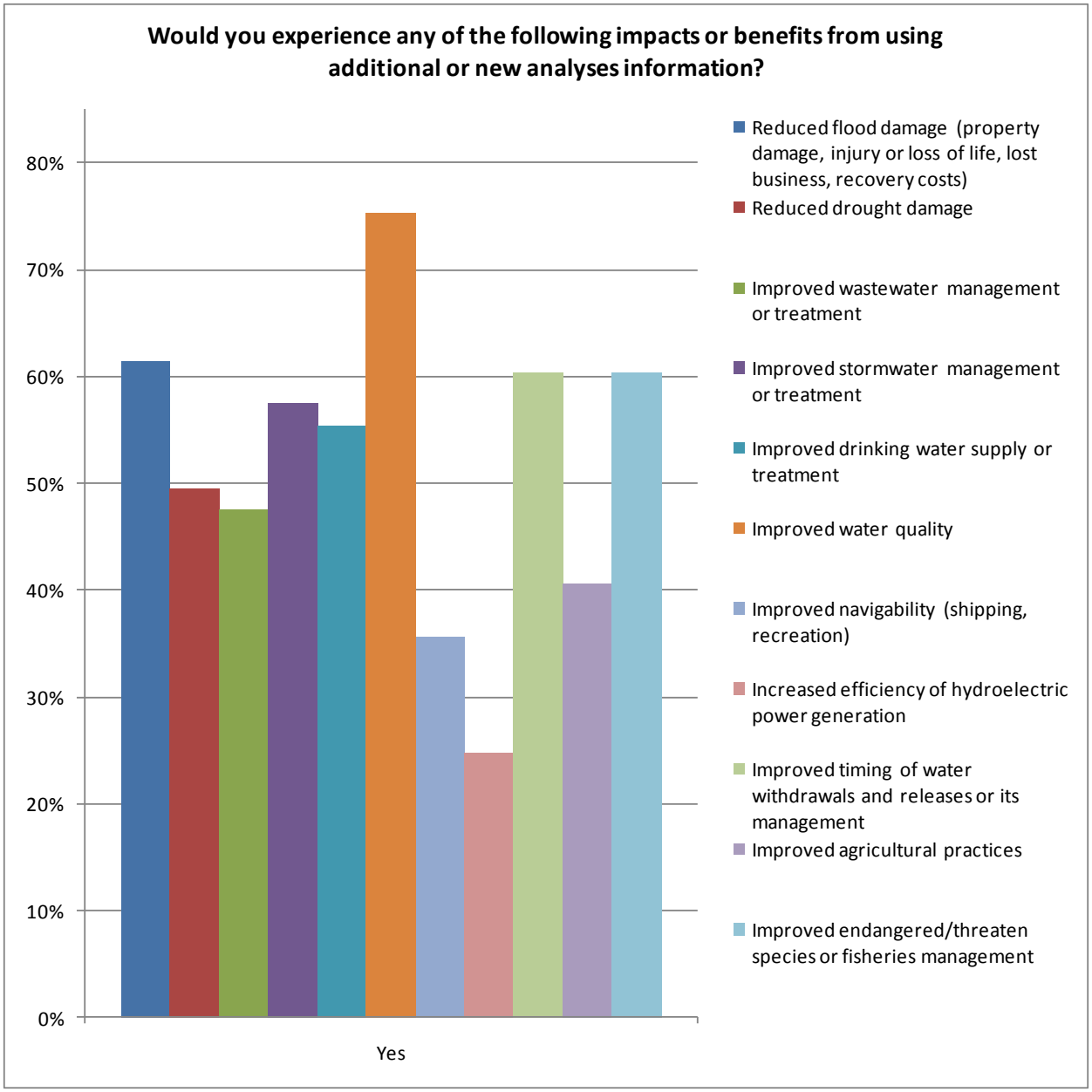


Figure 25: Summary of benefits of using new or additional analyses.

Appendix A
Survey Responses by Question

IWRSS Stakeholder Survey

Ohio River Basin Results, by Question

1) From the following list, please select the PRIMARY sector in which your work or interest is focused in the Ohio River basin? (Check one)

Sector	Count	Percent
Agriculture	1	1%
Recreation	1	1%
Other energy extraction	2	1%
Hydropower	3	2%
Reservoir Management	6	4%
Emergency Management	7	5%
River Commerce	7	5%
Other	8	5%
Municipal and Industrial Water Supply	13	8%
Flood Protection	17	11%
Fish and Wildlife	22	14%
Watershed Management	24	16%
Water Quality	42	27%
Total	**153**	**100%**

Other Responses
Basin planning for both quality & quantity
Biological assessment
Forestry
Regulatory
Scientific data and studies for those sectors
State Regulatory staff for water supply
USGS is involved in a number of areas
Monitoring

2) Please indicate any other sectors in which you work or that you are concerned about in the Ohio River basin? (Please check all that apply)

Sector	Count	Percent
Water Quality	87	57%
Fish and Wildlife	68	44%
Emergency Management	40	26%
Reservoir Management	42	27%
Watershed Management	88	58%
Agriculture	32	21%
Hydropower	32	21%
Other energy extraction	20	13%
River commerce	23	15%
Municipal and Industrial Water Supply	61	40%
Recreation	54	35%
Insurance	9	6%
Flood Protection	49	32%
Other (please specify)	11	7%
Total	**153**	**100%**

Other Responses
Aquatic Invasive Species
Asian carp
Climate adaptation and resilience
Ecosystems services
Mapping What & Where
Scientific data and studies for those sectors
Stormwater Management
Stormwater runoff
Water pollution
Conservation organization
Ecosystem services
Effects of climate change
Permitting

3) Please select the affiliation that best describes your work or interest in the Ohio River basin? (Check one)

Affiliation	Count	Percent
Left Blank/Skipped	0	0%
Private Citizen	2	1%
Academic	10	7%
Industry/Business	15	10%
Local Government	19	12%
Non-profit organization	23	15%
Federal Government	36	24%
State Government	48	31%
Total	**153**	**100%**

4) How many years have you been working on or interested in issues in the Ohio River basin?

Years	Count	Percent
Less than 5 years	14	9%
5-10 years	28	18%
11-15 years	23	15%
More than 15 years	86	56%
Left Blank/Skipped	2	1%
Total	**153**	**100%**

5) How many years have you been interested in issues related to water resources management?

Years	Count	Percent
Less than 5 years	8	5%
5-10 years	20	13%
11-15 years	18	12%
More than 15 years	104	68%
Left Blank/Skipped	3	2%
Total	**153**	**100%**

6) How frequently do you deal with issues related to water resources management?

Frequency	Count	Percent
Daily	97	63%
Weekly	25	16%
Monthly	17	11%
Less than once a month	13	8%
Left Blank/Skipped	1	1%
Total	**153**	**100%**

7) Do your job responsibilities include providing input to strategic planning; program, facility, operations or financial management; or project planning decisions on water resources information?

	Count	Percent
Yes	135	88%
No	18	12%
Total	**153**	**100%**

II. Priorities

8) How important are each of the following issues? (Please indicate the importance (to you) of each the following issues on a scale from 1 to 5; where 1 is "Not Important at All" and 5 is "Extremely Important.")

	Water Quality	Maintaining Hydrology	Water Supply, Withdrawals, Management	Flooding	Fish & Aquatic Habitat	Energy Production	Climate, Drought	Other
Not Important at all	0%	1%	1%	3%	1%	7%	5%	4%
Slightly important	1%	7%	3%	9%	5%	18%	7%	0%
Important	6%	18%	21%	22%	14%	33%	19%	2%
Moderately important	15%	31%	26%	24%	32%	25%	36%	2%
Extremely important	78%	42%	50%	42%	48%	18%	33%	8%

9) If you selected "Other" above, please use this space to describe your priority water resources issue.

Aquatic Invasive Species
Asian Carp and other ANS issues
Contact Recreation
Educating the public and elected officials about the importance of water quality and wildlife
Farm field runoff. It may be able to be lumped under impacts from runoff by land use conversions, but that sounds more like recent conversions
Hydropower and forecasting long and short term water availability
Improving biological assessment
Invasive species impact to the aquatic resources of the Ohio River Basin.
Maintaining ecosystem services.
Maintenance of L/D structures to protect water resources. Almost all the other issues will be WAY worse if the dams are not repaired and maintained.
Management of floodplains and land uses by county and municipal jurisdictions, administered outside of State or Federal authorities but instrumental in stormwater issues, flooding and water quality.
Outreach & Education
Recreational use of the rivers public access to the rivers.
Relationship with ground water
Riparian Corridor Protection
The unknown.
Public use
Thermal pollution

10) Looking at the issues as a group, please rank the three most important issues that you think are facing the Ohio River Basin, in order of importance; where 1 is the most important issue.

Priority Issue	Priority Issue #1		Priority Issue #2		Priority Issue #3	
	Count	Percent	Count	Percent	Count	Percent
Water Quality	79	52%	37	24%	12	8%
Maintaining Hydrology	17	11%	10	7%	23	15%
Water Supply Withdrawals, Management	15	10%	42	27%	37	24%
Flooding	22	14%	13	8%	20	13%
Fish & Aquatic Habitat	11	7%	32	21%	27	18%
Energy Production	3	2%	11	7%	4	3%
Climate, Drought	5	3%	8	5%	25	16%
Other	1	1%	0	0%	5	3%
Total	**153**	**100%**	**153**	**100%**	**153**	**100%**

III. Information Needs.

11) For your highest priority issue, describe your access to the following types of information needed for informing decisions.

	Observation		Forecast		Uncertainty		Analyses	
	N	Percent	N	Percent	N	Percent	N	Percent
I do not need this type of information	2	1%	12	8%	17	11%	10	7%
I have adequate information to meet my needs	52	34%	56	37%	42	27%	42	27%
I have the information, but it is not adequate or needs improvement	74	48%	55	36%	60	39%	72	47%
I need this type of information but currently have no or very limited access to it	25	16%	30	20%	34	22%	29	19%
Total	**153**	**100%**	**153**	**100%**	**153**	**100%**	**153**	**100%**

Observation Information Details

12) The observation information that you're interested in supports decision making over what time frames? Please check all that apply.

Time Frame	N	Percent
Immediate	45	30%
<1 Day	37	25%
1 to 3 days	50	33%
3 to 5 days	26	17%
5 to 7 days	31	21%
1 week to 1 month	44	29%
1 month to 1 year	43	28%
>1 year	54	36%
None of the above	0	0%
Total	**153**	**100%**

13) How often would you like to see new observation information made available for use?

Time Frame	N	Percent
Every 15 minutes or less	9	6%
15 minutes to 1 hour	11	7%
Hourly	45	30%
Daily	30	20%
Weekly	16	11%
Monthly	18	12%
Quarterly	9	6%
Annually	11	7%
None of the above	2	1%
Total	**153**	**100%**

Forecast Information Details

14) The forecast information that you're interested in supports decision making over what time frames? Please check all that apply.

Time Frame	N	Percent
Immediate	30	21%
<1 Day	25	18%
1 to 3 days	51	36%
3 to 5 days	29	21%
5 to 7 days	29	21%
1 week to 1 month	32	23%
1 month to 1 year	27	19%
>1 year	40	28%
None of the above	2	1%
Total	**153**	**100%**

15) How often would you like to see new forecast information made available for use?

Time Frame	N	Percent
Every 15 minutes or less	7	5%
15 minutes to 1 hour	7	5%
Hourly	35	25%
Daily	45	32%
Weekly	8	6%
Monthly	9	6%
Quarterly	12	9%
Annually	16	11%
None of the above	2	1%
Total	**153**	**100%**

Uncertainty Information Details

16) The uncertainty information that you're interested in supports decision making over what time frames? Please check all that apply.

Time Frame	N	Percent
Immediate	21	15%
<1 Day	17	13%
1 to 3 days	33	24%
3 to 5 days	22	16%
5 to 7 days	30	22%
1 week to 1 month	29	21%
1 month to 1 year	34	25%
>1 year	46	34%
None of the above	2	1%
Total	**153**	**100%**

17) How often would you like to see new uncertainty information made available for use?

Time Frame	N	Percent
Every 15 minutes or less	5	4%
15 minutes to 1 hour	2	1%
Hourly	17	13%
Daily	40	29%
Weekly	11	8%
Monthly	21	15%
Quarterly	11	8%
Annually	28	21%
None of the above	1	1%
Total	**153**	**100%**

17b) Does your organization use a formal mechanism or decision model with uncertainty information?

Response	N	Percent
No, my organization does not currently have an approach for using this information. [Please describe below]	63	41%
No, my organization uses a qualitative approach. [Please describe below]	33	22%
Yes, my organization uses a formal mechanism or decision model. [Please describe below]	33	22%
Skipped	24	16%
Total	**153**	**100%**

No, my organization does not currently have an approach for using this information. [Please describe below]
For reservoir management decision-making, we use a formal decision model, which includes inherent uncertainties related to various model parameters or inputs (such as rainfall observations or soil moisture states). These uncertainties are not quantified, or explicitly included, in the model outputs.
This information would be useful in making manpower decisions during flood conditions.
We do not possess this expertise.
We understand the forecasts have an inherent uncertainty factor. Forecast information is used as "guidance", and is not considered "absolute".
We use it to inject caution into our strategies
No, my organization uses a qualitative approach. [Please describe below]
1. What are the variations in sediment loading related to rainfall frequency and intensity? (This affects cooling water impacts on industrial piping wear and plugging. How is the water quality impact measured regarding sanitary and industrial sewage bypasses during storm events? This affects industrial discharge quality in once through cooling water systems.
A description of the uncertainty helps us to determine how concerned to be over potentially forecast outcomes--especially long term forecasts.
Based on COE AND NWS INFO
Based on historical frequencies
Peer Review
The marine department does this work predominantly, I am aware of the work but able to describe the approach to level I think you are requesting.
This centers mostly on interpretation of biological and water quality data - based on inference and variability in reference conditions.
Use information in making permit and water quality assessment decisions.

We rely upon NOAA for river flows and forecasts
We understand that there is inherent uncertainty in all we do, and thus are always considering that in our decision-making. For example, in flood forecasting and warning, we provide a range of possibilities with an understanding that we can never know exactly what will happen.
When making future projections for decision-making, we use a loose best case and worse case concept, and then plan for a "no regrets" strategy for decision making in most cases.
Yes, my organization uses a formal mechanism or decision model. [Please describe below]
A formal model is used for drought monitoring; separate sets of models are used for long-term water supply planning.
Developed in-house, surface water withdrawals are analyzed using a cumulative impact analysis that is essentially a water budget on a daily time-step. This allows the evaluation of a proposed withdrawal's (and its operating rules) potential impact on the existing system, and permit decisions are made based upon that analysis.
GIS based
Identifying/approving/permitting and assisting in the funding of regional approaches to water and wastewater needs is a critical statewide goal. It is well documented that regional water solutions are more sustainable, more energy efficient, economies of scale less costly for all tax payers, and less impactful to the environment. It's critical that the process involve a broad range of stakeholders. It cannot be, nor can it have the appearance of being, a top-down process. In TN, we are collaborating with federal, local and NGO partners to: 1) define "regional approaches"; and 2) provide economic incentives through SRF loan ranking for regional projects. Obtaining the very best hydrologic data for all of our state's surface and groundwater sources is critical in the process to best understand reliable yields of water bodies against growth projections.
ORSANCO Organics Detection System
Predicted flood stage to determine if sampling is safe and/or appropriate for collection of biological samples.
Pre-schedule of flow releases to max generation and value from available water
Risk models for life loss and flood damages
Several statistical "bootstrap" methods have been developed. Also, ensemble forecast technology has been very useful to us over the past 4 years and continued improvements would be welcome.
Strategic Habitat Conservation: an adaptive, iterative process of biological planning, conservation design, conservation delivery, monitoring, and research.
Use internal USACE software with risk and uncertainty models pulled into it
USEPA uses several uncertainty approaches, e.g., in HSPF studies (see: Report EPA/600/R-12/058F (Sept. 2013)
USGS has a number of QA/QC standards and methods that include uncertainty.
Varies by project.
We do whatever Louisville does.
We execute lower Ohio and Mississippi River flood control using a dynamic routing model.
We have participated in a Spill Management Information system program in conjunction with the Vanderbilt University and the Army COE for spills in the source water.
We need to forecast if the river level will be above 30 feet so we can make a call to cancel or continue with our Ohio River Paddlefest
We use our on statistical models based on historical data for forecasts with some statistical uncertainty included, however we do not account for climate changes, population change, etc. uncertainties.
Within my academic research we work on decision models with uncertainty.
(blank)
Don't know, different groups use various statistical or modeling approaches

Analyses Information Details

18) The analyses information that you're interested in supports decision making over what time frames? Please check all that apply.

Time Frame	N	Percent
Immediate	31	22%
<1 Day	27	19%
1 to 3 days	43	30%
3 to 5 days	26	18%
5 to 7 days	29	20%
1 week to 1 month	39	27%
1 month to 1 year	41	29%
>1 year	52	36%
None of the above	1	1%
Not Applicable	10	7%
Total	**153**	**100%**

19) How often would you like to see new analyses information made available for use?

Time Frame	N	Percent
Every 15 minutes or less	8	6%
15 minutes to 1 hour	5	3%
Hourly	28	20%
Daily	25	17%
Weekly	13	9%
Monthly	22	15%
Quarterly	16	11%
Annually	24	17%
None of the above	2	1%
Not Applicable	10	7%
Total	**153**	**100%**

IV. Barriers to Use and Benefits Section

20) You indicated that the observation information you need for informing decisions needs improvement or is unavailable. What are some of the barriers to using the following types of observation information?

Type of Information	N (total = 99)					
	Surface Hydrology	Groundwater Hydrology	Water Quality	Drainage Basin Management	Meteorology	Snow/Ice
Not available in a format that I can use	7	6	8	7	7	3
Don't know where to get the information	10	16	12	26	13	14
Accuracy is not sufficient	10	3	10	6	13	7
Consistency is not sufficient	11	7	18	9	14	5
Resolution is not sufficient	17	4	15	6	8	5
Not enough information available	56	37	53	38	31	16
Don't understand how information can be used	3	5	3	3	5	6
I don't use this type of information	3	28	6	14	18	45
Not applicable	54	54	54	54	54	54

21) If the observation information you needed were made available, would you experience any of the following benefits from using the additional or new observational information?

Types of impacts or benefits	N (total = 99)				
	Yes	No	Skipped	Not Applicable	Total
Reduced flood damage (property damage, injury or loss of life, lost business, recovery costs)	55	40	4	54	153
Reduced drought damage	45	50	4	54	153
Improved wastewater management or treatment	50	44	5	54	153
Improved stormwater management or treatment	62	32	5	54	153
Improved drinking water supply or treatment	58	37	4	54	153
Improved water quality	77	17	5	54	153
Improved navigability (shipping, recreation)	34	57	8	54	153
Increased efficiency of hydroelectric power generation	22	68	9	54	153
Improved timing of water withdrawals and releases or its management	63	29	7	54	153
Improved agricultural practices	42	49	7	55	153
Improved endangered/threaten species or fisheries management	66	27	6	54	153
Other type of impact?	10	39	50	54	153

22) If you selected "yes" for "other type of benefit," please provide a brief description. [Open-ended]

Ability to forecast water quality for recreation
Better understanding of limiting factors to biological assemblages.
Improved ability to accurately report on attainment of beneficial uses.
Improved water quality modeling (i.e. TMDLs). And Improved decision-making to target placement of best management practices.
Improved communication to/within state and federal water pollution regulatory agencies
Needed for sport fish management
Possibly reduce cost to upgrade aging infrastructure as a result of dam hazard reclassification

23) You indicated that the forecast information you need for informing decisions needs improvement or is unavailable. What are some of the barriers to using the following types of observation information?

Type of Information	N (total = 85)					
	Surface Hydrology	Groundwater Hydrology	Water Quality	Drainage Basin Management	Meteorology	Snow/Ice
Not available in a format that I can use	5	3	6	3	6	3
Don't know where to get the information	14	20	18	21	12	16
Accuracy is not sufficient	14	6	8	9	19	12
Consistency is not sufficient	11	5	9	14	15	5
Resolution is not sufficient	10	3	10	7	11	3
Not enough information available	44	31	41	31	27	14
Don't understand how information can be used	1	2	1	2	2	4
I don't use this type of information	2	21	8	11	10	33
Not applicable	68	68	68	68	68	68

24) If the forecast information you needed were made available, would you experience any of the following benefits from using the additional or new observational information?

Types of impacts or benefits	N (total = 85)				
	Yes	No	Skipped	Not Applicable	Total
Reduced flood damage (property damage, injury or loss of life, lost business, recovery costs)	56	27	2	68	153
Reduced drought damage	44	39	2	68	153
Improved wastewater management or treatment	41	40	4	68	153
Improved stormwater management or treatment	51	28	6	68	153
Improved drinking water supply or treatment	50	31	3	69	153
Improved water quality	68	12	5	68	153
Improved navigability (shipping, recreation)	38	43	4	68	153
Increased efficiency of hydroelectric power generation	23	56	6	68	153
Improved timing of water withdrawals and releases or its management	56	26	3	68	153
Improved agricultural practices	42	38	5	68	153
Improved endangered/threaten species or fisheries management	52	26	7	68	153
Other type of impact?	6	34	45	68	153

25) If you selected "yes" for "other type of benefit," please provide a brief description. [Open-ended]

Ability to let public know whether or not water quality is safe for recreation
Forecast information should be provided consistently with how flood risk information is provided and documented. For example, frequency and magnitude of rain events/storms is not consistent with frequency/magnitude of flood on a watercourse.
Improve public safety
Improved derivation of water quality criteria.
Ability to do correction action and groundwater clean up when contamination found.
Improved response to emergencies involving loss of electrical power to water and wastewater utilities

26) You indicated that the uncertainty information you need for informing decisions needs improvement or is unavailable. What are some of the barriers to using the following types of observation information?

Type of Information	N (total = 94)					
	Surface Hydrology	Groundwater Hydrology	Water Quality	Drainage Basin Management	Meteorology	Snow/Ice
Not available in a format that I can use	5	3	4	4	5	4
Don't know where to get the information	23	21	21	24	21	22
Accuracy is not sufficient	15	9	9	9	17	11
Consistency is not sufficient	14	9	12	12	10	5
Resolution is not sufficient	12	4	11	7	7	3
Not enough information available	40	32	42	31	25	19
Don't understand how information can be used	7	5	6	3	5	6
I don't use this type of information	3	25	6	10	14	33
Not applicable	59	59	59	59	59	59

27) If the uncertainty information you needed were made available, would you experience any of the following benefits from using the additional or new observational information?

Types of impacts or benefits	N (total = 94)				
	Yes	No	Skipped	Not Applicable	Total
Reduced flood damage (property damage, injury or loss of life, lost business, recovery costs)	56	35	3	59	153
Reduced drought damage	49	41	4	59	153
Improved wastewater management or treatment	41	48	5	59	153
Improved stormwater management or treatment	57	31	5	60	153
Improved drinking water supply or treatment	48	41	4	60	153
Improved water quality	71	20	3	59	153
Improved navigability (shipping, recreation)	35	52	7	59	153
Increased efficiency of hydroelectric power generation	24	63	6	60	153
Improved timing of water withdrawals and releases or its management	59	29	6	59	153
Improved agricultural practices	39	49	6	59	153
Improved endangered/threaten species or fisheries management	53	37	4	59	153
Other type of impact?	6	44	44	59	153

28) If you selected "yes" for "other type of benefit," please provide a brief description. [Open-ended]

Ability to convey to the public the reliability of forecasts
Because of the "science" behind flood prediction and monitoring, the public does not believe there is accurate depiction of risk. Less uncertainty in determining frequency and magnitude (more gages, better modeling, etc.) would improve acceptance and belief in risk communication tools.
Better prediction of effects on biological assemblages. More precise indicators and criteria.

29) You indicated that the analysis information you need for informing decisions needs improvement or is unavailable. What are some of the barriers to using the following types of observation information?

Type of Information	N (total = 101)					
	Public alerts	Meteorological analyses	Hydrologic analyses	Climatological analyses	Flood inundation mapping	Information integration
Not available in a format that I can use	5	5	9	7	6	11
Don't know where to get the information	21	19	26	27	30	43
Accuracy is not sufficient	17	19	13	16	14	6
Consistency is not sufficient	14	10	10	12	9	9
Resolution is not sufficient	17	15	17	14	17	8
Not enough information available	24	30	39	25	28	31
Don't understand how information can be used	3	1	2	7	1	3
I don't use this type of information	21	18	3	13	15	6
Not applicable	52	52	52	52	52	52

30) If the analysis information you needed were made available, would you experience any of the following benefits from using the additional or new observational information?

Types of impacts or benefits	N (total = 101)				
	Yes	No	Skipped	Not Applicable	Total
Reduced flood damage (property damage, injury or loss of life, lost business, recovery costs)	62	33	6	52	153
Reduced drought damage	50	46	5	52	153
Improved wastewater management or treatment	48	45	8	52	153
Improved stormwater management or treatment	58	35	8	52	153
Improved drinking water supply or treatment	56	37	8	52	153
Improved water quality	76	19	6	52	153
Improved navigability (shipping, recreation)	36	57	8	52	153
Increased efficiency of hydroelectric power generation	25	66	9	53	153
Improved timing of water withdrawals and releases or its management	61	31	9	52	153
Improved agricultural practices	41	50	9	53	153
Improved endangered/threaten species or fisheries management	61	33	7	52	153
Other type of impact?	5	42	0	52	153

31) If you selected "yes" for "other type of benefit," please provide a brief description. [Open-ended]

Better able to gauge the measures for specific Ohio R. projects - better benchmarking.
Cost savings and efficiency in hydrologic and hydraulic modeling are needed. Risk communication depends on comprehensive and timely analysis of flooding. Better ways to predict the impact of flooding, runoff, and development's impact are need

32) Are there any other types of information beyond observations, forecasts, uncertainty, and analyses that you believe need improvement and are critical for informing decisions?

	Count	Percent
No, there are not.	128	84%
Yes, there are.	25	16%
Total	153	100%

33) Please describe the other types of information that you believe need improvement and are critical for informing decisions: _____

Bacterial conditions
Better and more consistent chemical, physical, and biological data to form a more detailed assessment of the Ohio R. at multiple scales. Current scale of assessment is at pool level which is too coarse for emerging management needs.
Better historical information on the timing and details of policy decisions. I am sure that the information is available --- it just is not publicly accessible.
Better information on the integration and use of such information as pertains to policy development/implementation.
Better regional predictions for climate change impacts on water resources and aquatic habitat.
Condition of the infrastructure - what dam gates are out of operation; what hydropower turbines are out of operation; what levees are not up to standards or where they are breaching; what dams are high risk.
Consistently collected network of fish and aquatic habitat information at a broad scale
Explanations of the relevance and significance of information is also needed to accompany the data and analyses. How to apply the information to behaviors and decisions is equally important.
Future changes (plus or minus) in flow discharge due to climate change induced precipitation.
GIS Map information on location of potential accidental spills and water utility characteristics
I would like to see the three agencies work together more efficiently when reporting all the observations. Examples, flow gauges, water quality, meteorological, stream gauges, etc.
Information about engagement of stakeholders to help develop path forward for rehabilitating, renewing, or removing hydrologic management infrastructure.
Information intended to educate the public and elected officials on the importance of maintaining water quality and habitat
Lots of different agencies performing inundation-mapping studies. We would like to make sure there is one consistent go-to place for the static inundation mapping results
Ohio River water depth and bottom material in the river channel; riparian zone width and maturity along Mainstream Ohio River and flood plain tributaries.
Quick information sharing across the board with emergency management, before public dissemination!
Risk assessment tools that can be used by individual property owners, communities and watersheds need to be

developed to support hazard mitigation.
Statewide daily rainfall data at good resolution
Statistical and physical models and their assumptions. Forecasts might be great, but not if I don't know how they were made.
Water quality, pollution control standards adequate to protect aquatic and human health; recreational use; fish consumption
We need information on what kinds of data and tools are needed for water resource issues because we supply those scientific data, studies, and tools
What (quality) are the upstream river water users discharging and what is the frequency and volume of such?
Good and timely info
Not specific to water quality, but detailed information on watershed water budgets, including all inputs and outflows (specifically including embedded water) would be useful in management recommendations